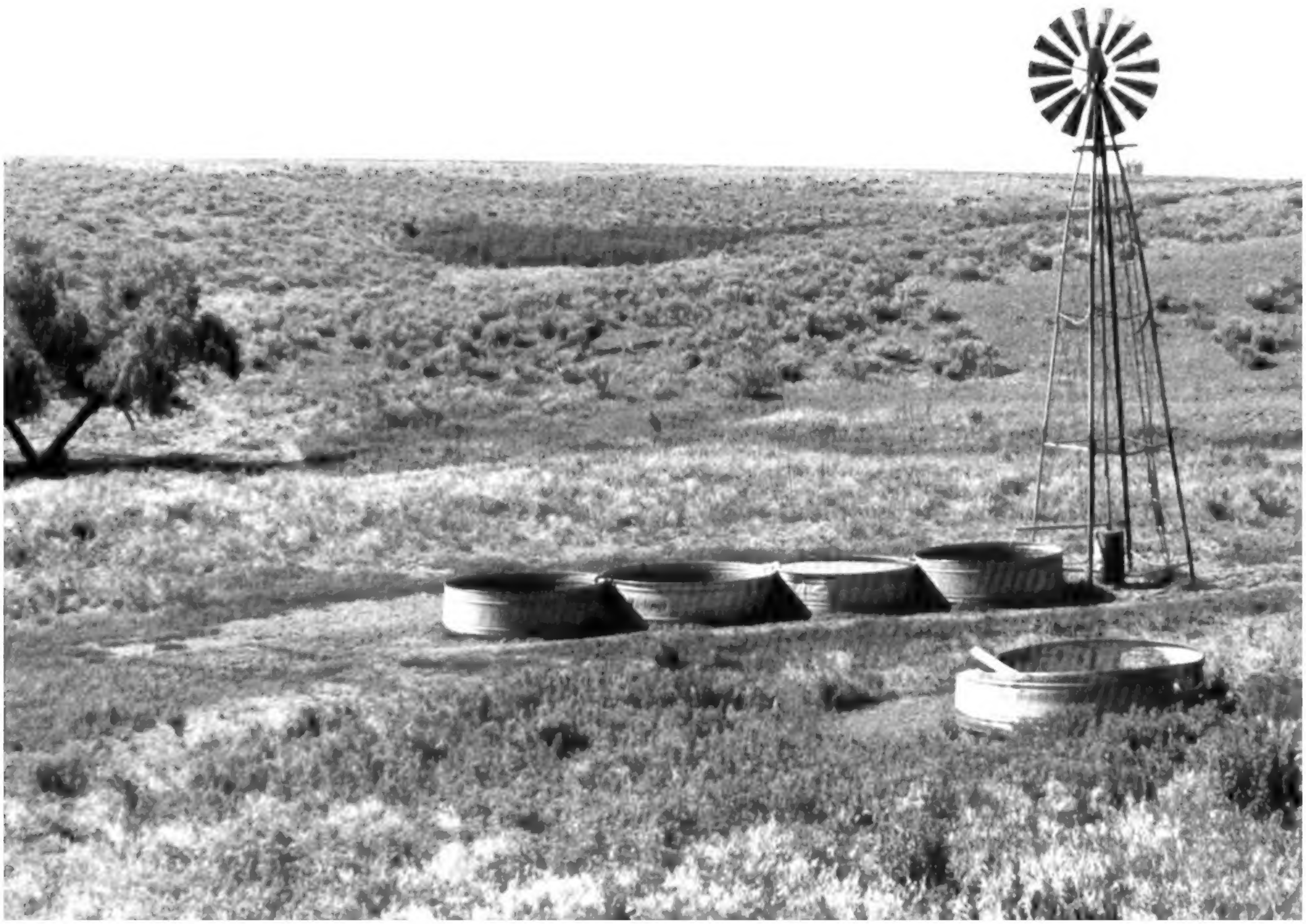
United States
Department of
Agriculture

Soil
Conservation
Service

In cooperation with the
Kansas Agricultural
Experiment Station

Soil Survey of Comanche County, Kansas



How To Use This Soil Survey

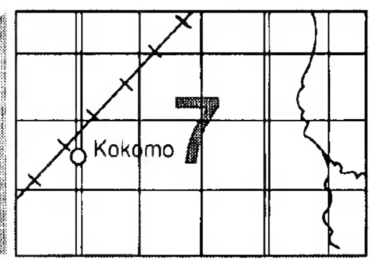
General Soil Map

The general soil map, which is the color map preceding the detailed soil maps, shows the survey area divided into groups of associated soils called general soil map units. This map is useful in planning the use and management of large areas.

To find information about your area of interest, locate that area on the map, identify the name of the map unit in the area on the color-coded map legend, then refer to the section **General Soil Map Units** for a general description of the soils in your area.

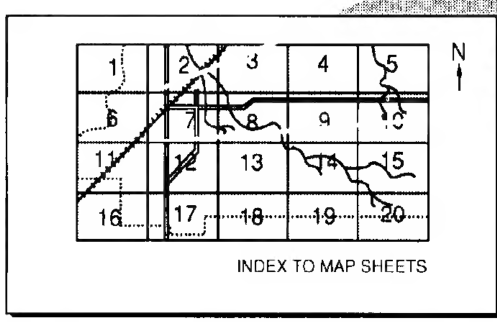
Detailed Soil Maps

The detailed soil maps follow the general soil map. These maps can be useful in planning the use and management of small areas.

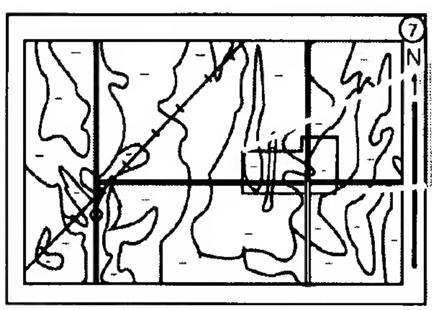


MAP SHEET

To find information about your area of interest, locate that area on the **Index to Map Sheets**, which precedes the soil maps. Note the number of the map sheet, and turn to that sheet.



Locate your area of interest on the map sheet. Note the map unit symbols that are in that area. Turn to the **Index to Map Units** (see Contents), which lists the map units by symbol and name and shows the page where each map unit is described.



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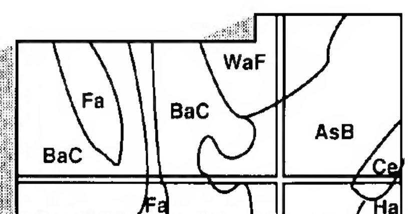

AREA OF INTEREST

NOTE: Map unit symbols in a soil survey may consist only of numbers or letters, or they may be a combination of numbers and letters.

The **Summary of Tables** shows which table has data on a specific land use for each detailed soil map unit. See **Contents** for sections of this publication that may address your specific needs.

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other federal agencies, state agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1986. Soil names and descriptions were approved in 1987. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1986. This survey was made cooperatively by the Soil Conservation Service and the Kansas Agricultural Experiment Station. It is part of the technical assistance furnished to the Comanche County Conservation District.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Windmill and stockwater tanks in an area of Albion-Shellabarger sandy loams, 4 to 15 percent slopes.

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Issued June 1989

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Foreword

This soil survey contains information that can be used in land-planning programs in Comanche County, Kansas. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

James N. Habiger
State Conservationist
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Soil Survey of Comanche County, Kansas

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United States Department of Agriculture, Soil Conservation Service,
in cooperation with the
Kansas Agricultural Experiment Station

General Nature of the County

Comanche County is in the south-central part of Kansas (fig. 1). It has an area of 505,082 acres, or about 789 square miles. In 1985, it had a population of 2,651. Coldwater, the county seat, had a population of 1,060. The county was established by an act of the state legislature in 1867. It was named after the Comanche Indian Tribe.

Comanche County is in the Central Rolling Red Plains major land resource area *(3)*. The broad divides on this dissected plain are nearly level or gently sloping. The valleys have short, steep slopes. In places they are bordered by an undulating to hilly, irregular dune topography. Local relief generally is slight, but some of the larger valleys are 100 feet or more below the general level of the plain.

The eastern part of the county is in the lower drainage basin of the Arkansas River. It is drained by Mule Creek, the Salt Fork of the Arkansas River, and the tributaries of these streams. The western part of the county is in the drainage basin of the Cimarron River. It is drained mainly by tributaries of the Cimarron River. The river cuts across the southwest corner of the county.

The highest elevation in the county is about 2,220 feet above sea level. It is in an area along the county line north of Coldwater. The lowest elevation is 1,580 feet above sea level. It is in an area along the Salt Fork of the Arkansas River near the Barber County line.

Wells are the major source of water in the county. They furnish water for domestic uses and for livestock.

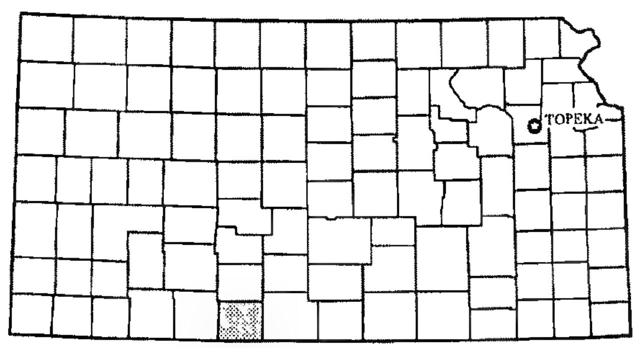

Figure 1.—Location of Comanche County in Kansas.

In the eastern and southern parts of the county, where shale and sandstone crop out, ponds furnish water for livestock.

A sufficient quantity of water for irrigation is available in the northern part of the county. The acreage of irrigated land in the county increased from 1,200 acres in 1967 to about 11,300 acres in 1985. Nearly all of this increase was the result of a growth in the popularity of pivot irrigation systems during the last 25 years. About 3,800 acres has been leveled and is irrigated by a flooding system.

Farming, ranching, oil production, and services related to these activities are the main enterprises in the county. About 64 percent of the county is range, 33 percent is cropland, and 3 percent consists of farmsteads, roads, and urban and other areas *(7)*. Grain sorghum and wheat are the principal crops.

Soil is the most important natural resource in the county. It provides a growing medium for cash crops and for the grasses grazed by livestock. Other natural resources are water, oil, gas, and sand and gravel. The sand and gravel are used for road surfacing.

Climate

Prepared by L. Dean Bark, climatologist, Kansas Agricultural Experiment Station, Manhattan, Kansas.

The climate of Comanche County is typical continental, as can be expected of a location in the interior of a large landmass in the middle latitudes. The climate is characterized by large daily and annual variations in temperature. Winters are cold because of frequent outbreaks of polar air. The cold temperatures prevail only from December to February. Warm summer temperatures prevail for about 6 months every year. They provide a long growing season for the crops grown in the county. Spring and fall are relatively short.

Comanche County is generally to the west of the flow of moisture-laden air from the Gulf of Mexico and is to the east of the strong rain-shadow effects of the Rocky Mountains. As a result, the annual amount of precipitation is marginal for cropping year after year. The precipitation generally falls during showers and thunderstorms that can be extremely heavy at times. Winds are relatively high and can cause significant soil loss and crop damage in the drier years.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Coldwater in the period 1951 to 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 35.3 degrees F, and the average daily minimum temperature is 22.7 degrees. The lowest temperature on record, which occurred at Coldwater on January 12, 1912, is -18 degrees. In summer the average temperature is 79.2 degrees, and the average daily maximum temperature is 93.1 degrees. The highest recorded temperature, which occurred at Coldwater on August 12 and 13, 1936, is 115 degrees.

The total annual precipitation is 23.98 inches. Of this, 17.41 inches, or about 73 percent, usually falls in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 11 inches. The heaviest 1-day rainfall on record was 4.8 inches at Coldwater on September 17, 1906, and October 21, 1920.

Severe windstorms and tornadoes accompany well developed thunderstorms, but they are infrequent and of limited extent. The losses caused by hail are more severe, but they are not so great as the losses in counties to the west of this county.

The average seasonal snowfall is 17.2 inches. The highest recorded seasonal snowfall, which occurred during the winter of 1911-12, is 45.5 inches. On the average, 16 days of the year have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The sun shines 74 percent of the time possible in summer and 63 percent in winter. The prevailing wind is from the south. Average windspeed is highest, 15.5 miles per hour, in March.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; the kinds of crops and native plants growing on the soils; and the kinds of bedrock. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biologic activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, the landforms, relief, climate, and the natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with considerable accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually

change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, soil reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpreted the data from these analyses and tests as well as the field-observed characteristics and the soil properties in terms of expected behavior of the soils under different uses. Interpretations for all of the soils were field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and new interpretations sometimes are developed to meet local needs. Data were assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management were assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can state with a fairly high degree of probability that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by several kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They may or may not be mentioned in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are mentioned in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure

taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

Map Unit Descriptions

This section describes the map units in the survey area at two levels of detail. The general soil map units, called soil associations, are described first and then the detailed map units. Most of the general soil map units represent the soils of major extent in the survey area. The detailed map units represent all of the named soils in the survey area.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

The descriptions and names of the soils identified on the general soil map of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications of series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

1. Abilene-Clark-Case Association

Deep, nearly level to strongly sloping, well drained soils that have a dominantly clayey or loamy subsoil; on uplands

This association is on ridgetops and side slopes that are dissected by intermittent streams. In places it is cut by entrenched drainageways. Slopes range from 0 to 15 percent.

This association makes up about 7 percent of the county. It is about 35 percent Abilene soils, 30 percent Clark soils, 25 percent Case soils, and 10 percent minor soils (fig. 2).

The nearly level and gently sloping Abilene soils formed in calcareous old alluvium on ridgetops and side slopes. Typically, the surface soil is grayish brown silt loam about 8 inches thick. The subsoil is about 41 inches thick. It is firm. The upper part is grayish brown silty clay loam; the next part is grayish brown and brown silty clay that is calcareous below a depth of about 24 inches; and the lower part is pale brown, calcareous silty clay loam. The substratum to a depth of about 60 inches is light brown, calcareous clay loam.

The nearly level to strongly sloping Clark soils formed in calcareous old alluvium on ridgetops and side slopes. Typically, the surface layer is grayish brown, calcareous clay loam about 10 inches thick. The subsoil is friable, calcareous clay loam about 14 inches thick. The upper part is brown, and the lower part is light yellowish brown and has many concretions of lime. The substratum to a depth of about 60 inches is very pale brown, calcareous clay loam.

The gently sloping to strongly sloping Case soils formed in calcareous old alluvium on side slopes. Typically, the surface layer is brown, calcareous clay loam about 8 inches thick. The subsoil is friable, calcareous clay loam about 19 inches thick. It is yellowish brown in the upper part and light brown in the lower part. The substratum to a depth of about 60 inches is light brown, calcareous clay loam.

The minor soils in this association are the Dale, Elandco, and Kingsdown soils. Dale soils are on stream terraces, and Elandco soils are on flood plains. Kingsdown soils are on knobs and ridgetops.

This association is used mainly for cultivated crops. The steeper areas are used as range. Wheat and grain sorghum are the main crops. Controlling water erosion, conserving moisture, and maintaining tilth and fertility

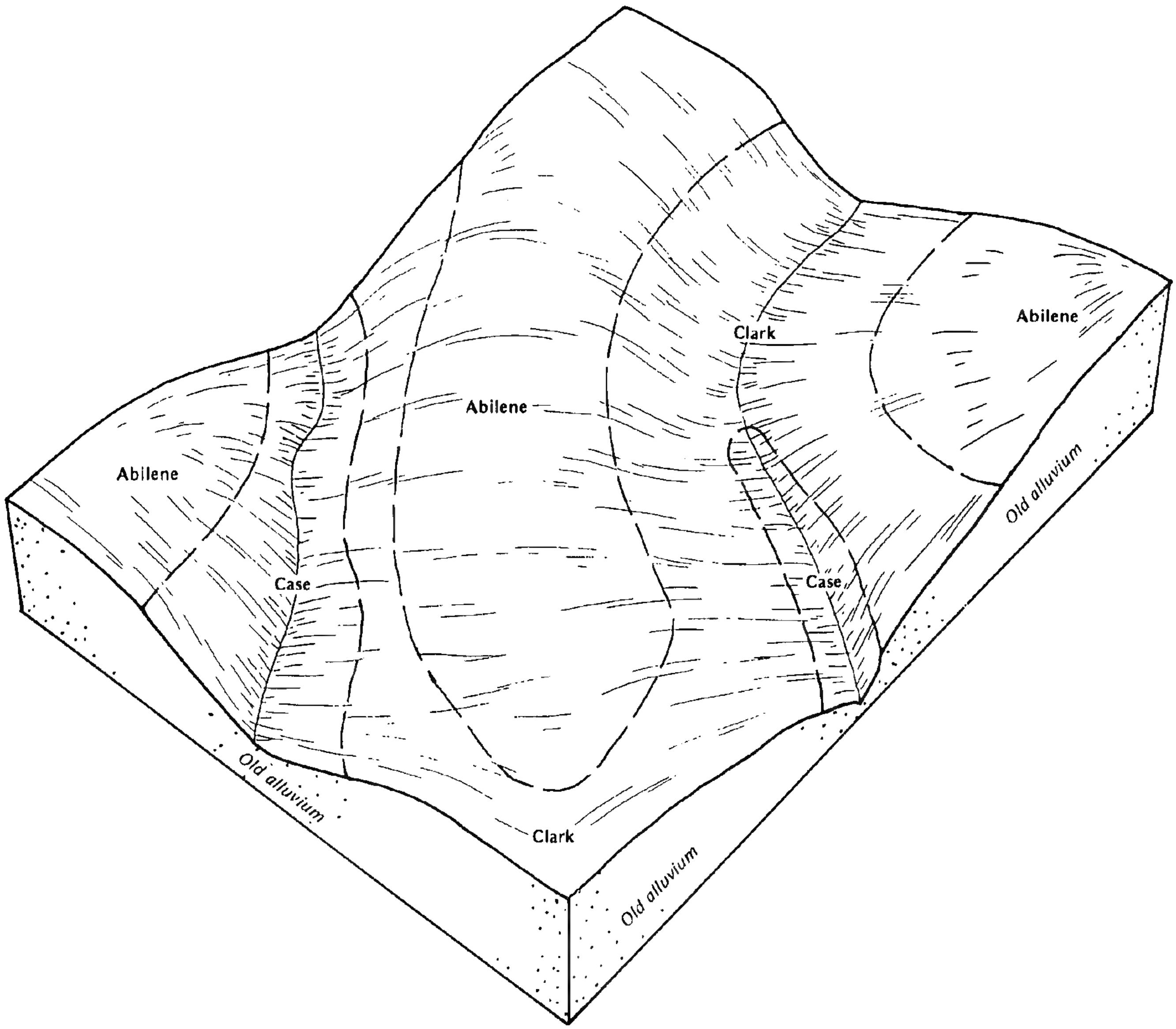

Figure 2.—Typical pattern of soils and parent material in the Abilene-Clark-Case association.

are the main concerns in managing the cultivated areas. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range.

2. Clark-Case-Kingsdown Association

Deep, nearly level to strongly sloping, well drained soils that have a loamy subsoil; on uplands

This association is on ridgetops and side slopes. In places it is cut by entrenched drainageways. Slopes range from 0 to 15 percent.

This association makes up about 9 percent of the county. It is about 40 percent Clark soils, 25 percent Case soils, 15 percent Kingsdown soils, and 20 percent minor soils.

The nearly level to strongly sloping Clark soils formed in calcareous old alluvium on ridgetops and side slopes. Typically, the surface layer is grayish brown,

calcareous clay loam about 10 inches thick. The subsoil is friable, calcareous clay loam about 14 inches thick. The upper part is brown, and the lower part is light yellowish brown and has many concretions of lime. The substratum to a depth of about 60 inches is very pale brown, calcareous clay loam.

The gently sloping to strongly sloping Case soils formed in calcareous old alluvium on side slopes. Typically, the surface layer is brown, calcareous clay loam about 8 inches thick. The subsoil is friable, calcareous clay loam about 19 inches thick. It is yellowish brown in the upper part and light brown in the lower part. The substratum to a depth of about 60 inches is light brown, calcareous clay loam.

The nearly level to moderately sloping Kingsdown soils formed in loamy, calcareous eolian material. Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil is brown, very friable, calcareous fine sandy loam about 14 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, calcareous fine sandy loam.

The minor soils in this association are the Abilene, Albion, Ost, and Shellabarger soils. Abilene and Ost soils are on ridges. Albion and Shellabarger soils are on the lower side slopes.

About half of this association is used for cultivated crops, and half is used as range. Wheat and grain sorghum are the main crops. Controlling water erosion and soil blowing, conserving moisture, and maintaining tilth and fertility are the main management concerns in cultivated areas. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range.

3. Albion-Shellabarger Association

Deep, nearly level to strongly sloping, somewhat excessively drained and well drained soils that have a dominantly loamy subsoil; on uplands

This association is on narrow ridgetops and side slopes that are dissected by intermittent streams. Slopes range from 0 to 15 percent.

This association makes up about 26 percent of the county. It is about 40 percent Albion soils, 30 percent Shellabarger soils, and 30 percent minor soils (fig. 3).

The somewhat excessively drained, gently sloping to strongly sloping Albion soils formed in loamy sediments over sandy alluvium. They are on ridgetops and side slopes. Typically, the surface layer is brown sandy loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is strong brown, friable sandy loam, and the lower part is reddish yellow, very friable loamy sand. The substratum to a depth of about 60 inches is light yellowish brown sand.

The well drained, nearly level to strongly sloping Shellabarger soils formed in old alluvium on ridgetops and side slopes. Typically, the surface soil is brown sandy loam about 11 inches thick. The subsoil is friable sandy clay loam about 27 inches thick. It is reddish brown in the upper part and reddish yellow in the lower part. The substratum to a depth of about 60 inches is reddish yellow, calcareous sandy loam.

The minor soils in this association are the Case, Clark, Farnum, Holdrege, Kingsdown, and Lincoln soils. The calcareous Case and Clark soils are on knobs and side slopes. Farnum and Holdrege soils are on ridgetops. Kingsdown soils are on knobs and ridgetops. The somewhat excessively drained Lincoln soils are on flood plains.

Most of this association is used as range. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range.

4. Quinlan-Woodward-Carey Association

Shallow to deep, nearly level to steep, well drained soils that have a loamy subsoil; on uplands

This association is on ridgetops and side slopes that are dissected by drainageways. Slopes range from 0 to 30 percent.

This association makes up about 26 percent of the county. It is about 30 percent Quinlan soils, 25 percent Woodward soils, 20 percent Carey soils, and 25 percent minor soils (fig. 4).

The shallow, moderately sloping to steep Quinlan soils formed in material weathered from soft, calcareous, fine grained sandstone on the steeper, upper side slopes. Typically, the surface layer is yellowish red, calcareous loam about 7 inches thick. The subsoil is red, friable, calcareous loam about 7 inches thick. Weakly cemented, calcareous sandstone bedrock is at a depth of about 14 inches.

The moderately deep, gently sloping to moderately steep Woodward soils formed in material weathered from soft, calcareous, fine grained sandstone on ridgetops and the lower side slopes. Typically, the surface layer is reddish brown loam about 7 inches thick. The subsoil is friable, calcareous loam about 23 inches thick. The upper part is reddish brown, and the lower part is red. Weakly cemented, calcareous sandstone bedrock is at a depth of about 30 inches.

The deep, nearly level and gently sloping Carey soils formed in material weathered from Permian red beds on side slopes and ridgetops. Typically, the surface layer is

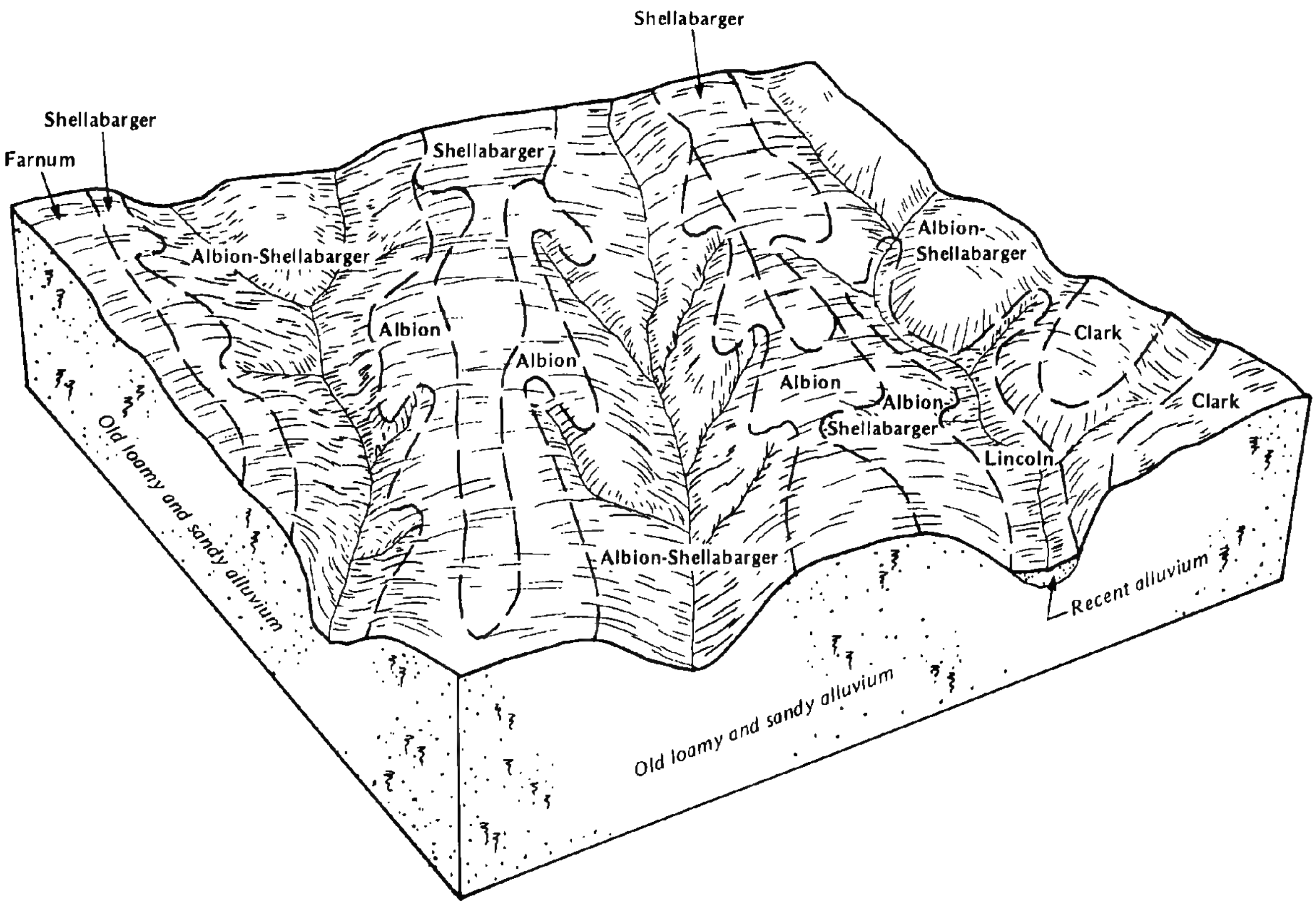

Figure 3.—Typical pattern of soils and parent material in the Albion-Shellabarger association.

brown silt loam about 10 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil is about 19 inches thick. It is friable and calcareous. The upper part is brown loam, and the lower part is light brown clay loam. The substratum to a depth of about 60 inches is light reddish brown, calcareous loam.

The minor soils in this association are the shallow, somewhat excessively drained Hedville soils, the moderately deep Lancaster soils, the deep St. Paul soils, and the shallow Wellsford soils. Hedville, Lancaster, and Wellsford soils are on ridgetops and the upper side slopes. St. Paul soils are on ridgetops and the lower side slopes. Also of minor extent are rock outcrops on steep side slopes.

Most of this association is used as range. The less sloping areas are used for cultivated crops. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range. Controlling water erosion, conserving moisture, and maintaining tilth and fertility are the main concerns in managing the cultivated areas.

5. St. Paul-Carey-Quinlan Association

Deep and shallow, nearly level to steep, well drained soils that have a silty or loamy subsoil; on uplands

This association is on ridgetops and side slopes that are drained by intermittent streams. In places it is cut by entrenched drainageways. Slopes range from 0 to 30 percent.

This association makes up about 4 percent of the county. It is about 40 percent St. Paul soils, 30 percent Carey soils, 20 percent Quinlan soils, and 10 percent minor soils.

The deep, nearly level and gently sloping St. Paul soils formed in silty material weathered from red beds

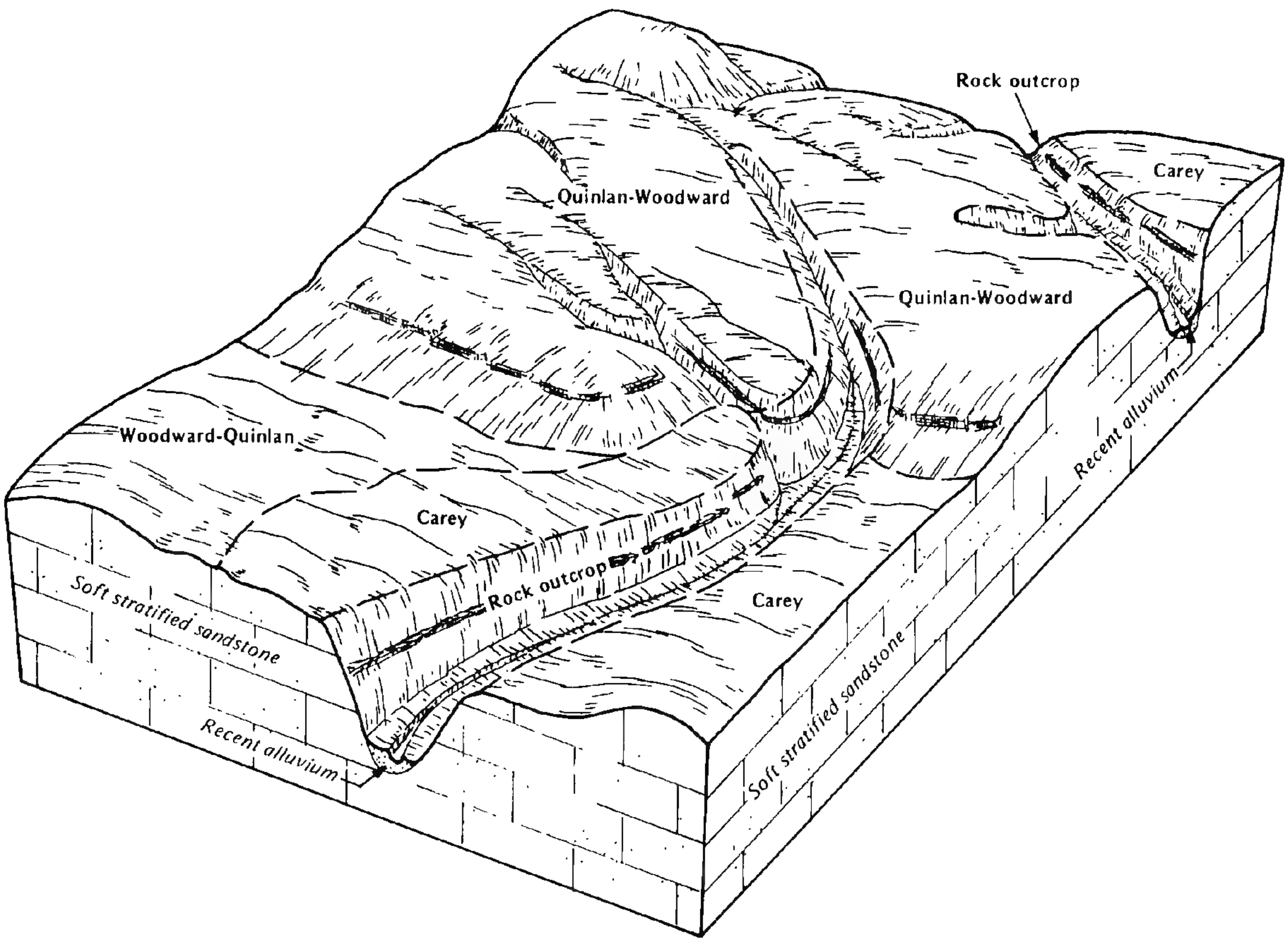

Figure 4.—Typical pattern of soils and parent material in the Quinlan-Woodward-Carey association.

on ridgetops. Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is friable silty clay loam about 32 inches thick. The upper part is brown, the next part is reddish brown, and the lower part is reddish brown and calcareous. The substratum to a depth of about 60 inches is yellowish red, calcareous silt loam.

The deep, nearly level and gently sloping Carey soils formed in material weathered from Permian red beds on ridgetops and side slopes. Typically, the surface layer is brown silt loam about 10 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil is about 19 inches thick. It is friable and calcareous. The upper part is brown loam, and the lower part is light brown clay loam. The substratum to a depth of about 60 inches is light reddish brown, calcareous loam.

The shallow, moderately sloping to steep Quinlan soils formed in material weathered from soft, calcareous, fine grained sandstone on the lower side slopes. Typically, the surface layer is yellowish red, calcareous loam about 7 inches thick. The subsoil is red, friable, calcareous loam about 7 inches thick. Weakly cemented, calcareous sandstone bedrock is at a depth of about 14 inches.

The minor soils in this association are the moderately deep Woodward soils on the lower side slopes.

This association is used mainly for cultivated crops. Wheat and grain sorghum are the main crops. Controlling water erosion, conserving moisture, and maintaining tilth and fertility are the main management concerns.

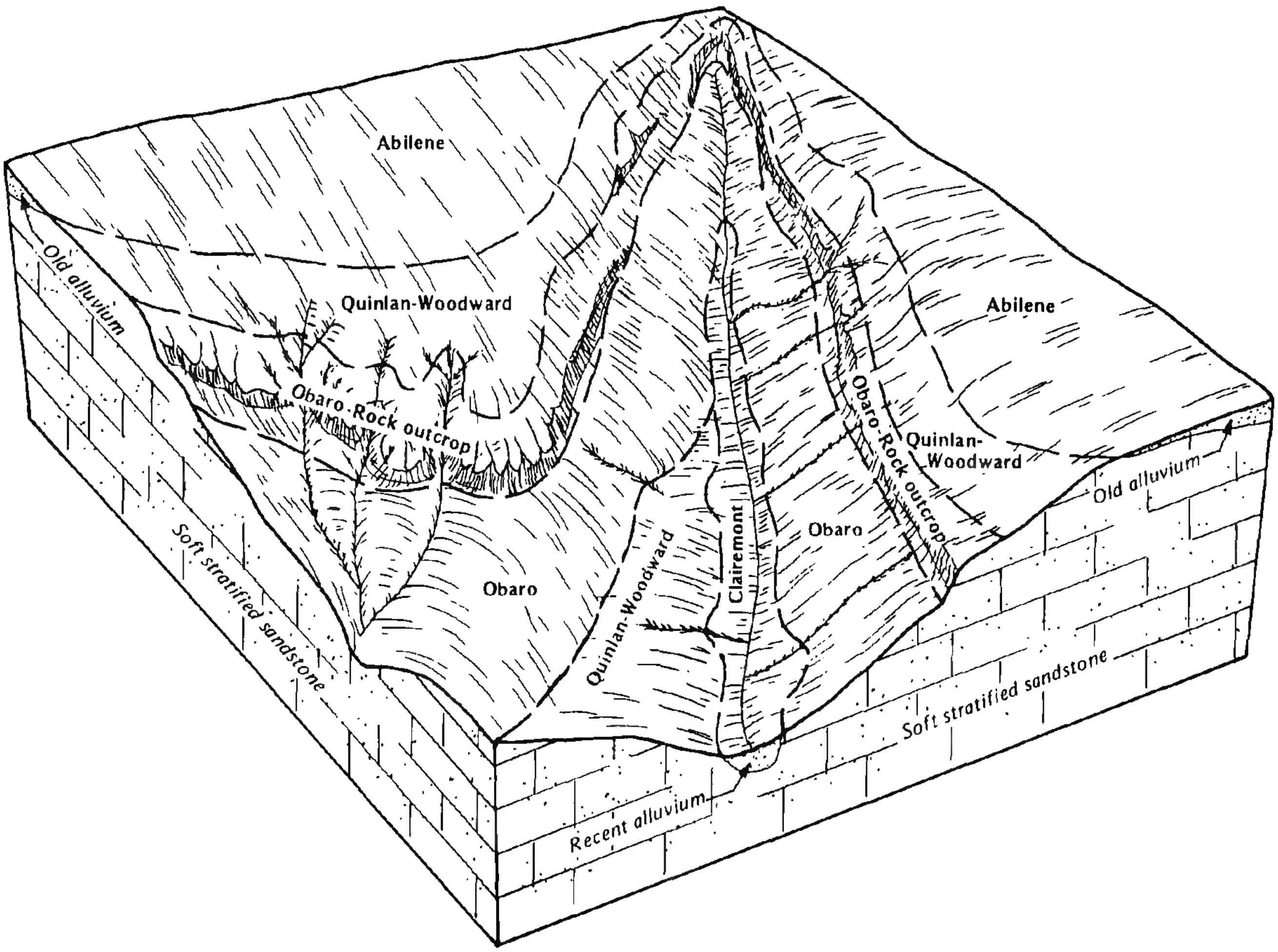

Figure 5.—Typical pattern of soils and parent material in the Obaro-Abilene association.

6. Obaro-Abilene Association

Moderately deep and deep, nearly level to strongly sloping, well drained soils that have a clayey or silty subsoil; on uplands

This association is on ridgetops and side slopes that are dissected by intermittent drainageways. Slopes range from 0 to 15 percent.

This association makes up about 5 percent of the county. It is about 40 percent Obaro soils, 30 percent Abilene soils, and 30 percent minor soils (fig. 5).

The moderately deep, moderately sloping and strongly sloping Obaro soils formed in material weathered from fine grained sandstone on ridgetops and side slopes. Typically, the surface layer is reddish brown silty clay loam about 7 inches thick. The subsoil is reddish brown, calcareous silty clay loam about 28 inches thick. It is friable in the upper part and firm in the lower part. Fine grained sandstone bedrock is at a depth of about 35 inches.

The deep, nearly level and gently sloping Abilene soils formed in calcareous old alluvium on ridgetops and side slopes. Typically, the surface soil is grayish brown silt loam about 8 inches thick. The subsoil is about 41 inches thick. It is firm. The upper part is grayish brown silty clay loam; the next part is grayish brown and brown silty clay that is calcareous below a depth of about 24 inches; and the lower part is pale brown, calcareous silty clay loam. The substratum to a depth of about 60 inches is light brown, calcareous clay loam.

The minor soils in this association are the deep,

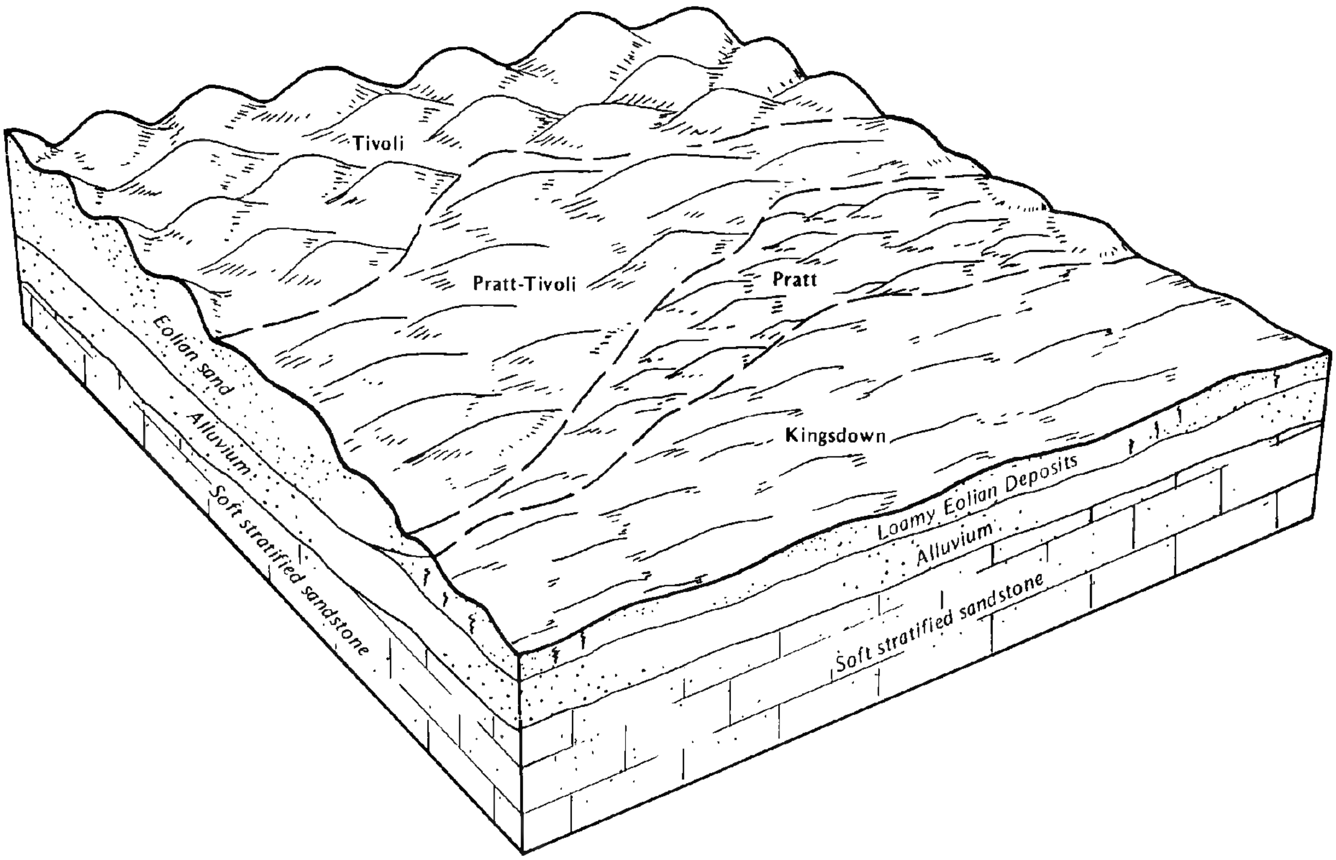

Figure 6.—Typical pattern of soils and parent material in the Pratt-Tivoli-Kingsdown association.

somewhat excessively drained Albion soils, the deep Clairemont soils, the shallow Quinlan soils, the deep Shellabarger soils, and the moderately deep Woodward soils. Albion, Quinlan, Shellabarger, and Woodward soils are on the upper side slopes, and Clairemont soils are on flood plains. Also of minor extent are rock outcrops on steep side slopes.

Most of this association is used as range. The less sloping areas are used for cultivated crops. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range. Controlling water erosion, conserving moisture, and maintaining tilth and fertility are the main concerns in managing the cultivated areas.

7. Pratt-Tivoli-Kingsdown Association

Deep, nearly level to hilly, well drained and excessively drained soils that have a sandy or loamy subsoil or that are sandy throughout; on uplands

This association is on knolls, hills, and nearly level to rolling uplands. Slopes range from 0 to 30 percent.

This association makes up about 8 percent of the county. It is about 40 percent Pratt soils, 25 percent Tivoli soils, 20 percent Kingsdown soils, and 15 percent minor soils (fig. 6).

The well drained, undulating to rolling Pratt soils formed in sandy eolian deposits on the lower side slopes. Typically, the surface layer is brown loamy fine sand about 9 inches thick. The subsoil is brown, very friable loamy fine sand about 22 inches thick. The substratum to a depth of about 60 inches is reddish yellow loamy fine sand.

The excessively drained, gently rolling to hilly Tivoli soils formed in sandy eolian deposits on hills, the crest of knolls, and the upper side slopes. Typically, the surface layer is brown fine sand about 6 inches thick. The substratum to a depth of about 60 inches is light yellowish brown fine sand.

The well drained, nearly level to moderately sloping Kingsdown soils formed in calcareous loamy eolian deposits on the lower parts of the landscape. Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil is brown, calcareous, very friable fine sandy loam about 14 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, calcareous fine sandy loam.

The minor soils in this association are the poorly drained Kanza, somewhat excessively drained Lincoln, and somewhat poorly drained Waldeck soils. All of these soils are on flood plains.

Most of this association is used as range. In some areas the Pratt and Kingsdown soils are used for cultivated crops, mainly wheat and grain sorghum. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range. Controlling soil blowing, maintaining fertility, and conserving moisture are the main concerns in managing the cultivated areas.

8. Lincoln-Waldeck Association

Deep, nearly level, somewhat excessively drained and somewhat poorly drained soils that have a sandy or loamy subsoil; on flood plains

This association is on flood plains along the major streams in the county. The major soils are occasionally flooded. Slopes generally range from 0 to 2 percent.

This association makes up about 9 percent of the county. It is about 40 percent Lincoln soils, 30 percent Waldeck soils, and 30 percent minor soils.

The somewhat excessively drained Lincoln soils formed in sandy alluvium. Typically, the surface layer is brown, calcareous loamy sand about 10 inches thick. The next layer is light yellowish brown, calcareous, loose loamy sand about 12 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous sand.

The somewhat poorly drained Waldeck soils formed in loamy and sandy alluvium. Typically, the surface soil is grayish brown, calcareous fine sandy loam about 13 inches thick. The next 13 inches is brown, very friable, calcareous fine sandy loam that is mottled below a depth of 20 inches. The upper part of the substratum is yellowish brown, mottled, calcareous fine sandy loam. The lower part to a depth of about 60 inches is very pale brown, calcareous sand.

The minor soils in this association are the well drained Canadian and Kaski soils on stream terraces, the somewhat poorly drained Krier, Lesho, and Zenda and well drained Yahola soils on flood plains, and the well drained Pratt and excessively drained Tivoli soils on rolling or hilly uplands.

Most of this association is used as range. Some areas are used for cultivated crops, mainly wheat, grain sorghum, and alfalfa. Maintaining the growth and vigor of desirable grasses and forbs is the main concern in managing range. Controlling soil blowing and flooding and maintaining tilth and fertility are the main concerns in managing the cultivated areas.

9. Westview-Dale Association

Deep, nearly level, well drained soils that have a silty subsoil; on stream terraces

This association is on terraces along the major streams. The Dale soils are subject to rare flooding. Slopes range from 0 to 2 percent.

This association makes up about 6 percent of the county. It is about 50 percent Westview soils, 25 percent Dale soils, and 25 percent minor soils.

The Westview soils formed in calcareous, silty alluvium or in loess and alluvium. Typically, the surface layer is brown silt loam about 5 inches thick. The subsurface layer is brown silt loam about 10 inches thick. The subsoil is calcareous silty clay loam about 35 inches thick. The upper part is brown and friable, the next part is light reddish brown and firm, and the lower part is light reddish brown and firm. The substratum to a depth of about 60 inches is light reddish brown, calcareous silty clay loam.

The Dale soils formed in silty alluvium. Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown silt loam about 16 inches thick. The subsoil is grayish brown, calcareous, firm silty clay loam about 13 inches thick. The substratum to a depth of about 60 inches is brown, calcareous silty clay loam.

The minor soils in this association are the moderately well drained, saline Buttermilk soils on stream terraces, the occasionally flooded Clairemont and Port soils on flood plains, the nearly level and gently sloping Clark soils on uplands, and the nearly level and gently sloping Kingsdown soils on knolls and ridgetops.

Nearly all of this association is used for cultivated crops. Wheat, grain sorghum, and alfalfa are the main crops. Controlling soil blowing, conserving moisture, and maintaining tilth and fertility are the main management concerns.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area.

The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the substratum. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such d fferences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Pratt loamy fine sand, undulating, is a phase of the Pratt series.

Some map units are made up of two or more major soils. These map units are called soil complexes. A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Clark-Kingsdown complex, 5 to 12 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

The descriptions and names of the soils identified on the detailed soil maps of this county do not fully agree with those of the soils identified on the maps of adjacent counties. Differences result from a better knowledge of soils, modifications in series concepts, a higher or lower intensity of mapping, and variations in the extent of the soils in the counties.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

Ab—Abilene silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on the broad tops of ridges in the uplands. Individual areas are irregular in shape and range from 40 to several hundred acres in size.

Typically, the surface layer is brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown silt loam about 5 inches thick. The subsoil is about 37 inches thick. It is firm. In sequence downward, it is dark grayish brown silty clay loam; grayish brown silty clay; grayish brown, calcareous silty clay; and pale brown, calcareous silty clay loam. The substratum to a depth of about 60 inches is light yellowish brown, calcareous silty clay loam.

Permeability is moderately slow, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate throughout the soil. The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. Inadequate rainfall is a problem if cultivated crops are grown. Summer fallowing helps to conserve moisture. It is most effective when the crop residue is managed by stubble mulching or by chemical fallow. Minimizing tillage also helps to conserve moisture. Returning crop residue to the soil and adding other organic material improve fertility and tilth and increase the rate of water infiltration.

This soil is moderately well suited to dwellings, well suited to sewage lagoons, and poorly suited to septic tank absorption fields. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. The moderately slow

permeability restricts the absorption of effluent in septic tank absorption fields. Increasing the size of the absorption field or installing the lateral lines below the subsoil helps to overcome this limitation.

The land capability classification is IIc, dryland, and the range site is Loamy Upland.

Ac—Abilene silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is in convex areas on ridgetops and side slopes in the uplands. Individual areas are irregular in shape and range from 30 to several hundred acres in size.

Typically, the surface soil is grayish brown silt loam about 8 inches thick. The subsoil is about 41 inches thick. It is firm. The upper part is grayish brown silty clay loam; the next part is grayish brown and brown silty clay that is calcareous below a depth of about 24 inches; and the lower part is pale brown, calcareous silty clay loam. The substratum to a depth of about 60 inches is light brown, calcareous clay loam.

Included with this soil in mapping are small areas of the calcareous Clark soils. These soils have a subsoil that is less clayey than that of the Abilene soil. They are in the slightly lower positions on the landscape. They make up about 10 percent of the map unit.

Permeability is moderately slow in the Abilene soil, and runoff is medium. Available water capacity and natural fertility are high. The shrink-swell potential is moderate throughout the soil. The surface layer is friable, and t lth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, establishing grassed waterways, farming on the contour, leaving crop residue on the surface, and minimizing tillage help to control runoff and erosion and conserve moisture.

This soil is moderately well suited to dwellings and sewage lagoons. It is poorly suited to septic tank absorption fields. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material help to prevent the structural damage caused by shrinking and swelling. The moderately slow permeability restricts the absorption of effluent in septic tank absorption fields. Increasing the size of the absorption field or installing the lateral lines below the subsoil helps to overcome this limitation. The slope is a limitation on sites for sewage lagoons. Some land shaping commonly is needed.

The land capability classification is IIe, dryland, and the range site is Loamy Upland.

An—Albion sandy loam, 1 to 4 percent slopes. This deep, gently sloping, somewhat excessively drained soil is on ridgetops and side slopes in the uplands. Individual areas are irregular in shape and range from 30 to several hundred acres in size.

Typically, the surface layer is brown sandy loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is strong brown, friable sandy loam, and the lower part is reddish yellow, very friable loamy sand. The substratum to a depth of about 60 inches is light yellowish brown sand.

Included with this soil in mapping are small areas of Clark, Farnum, and Shellabarger soils. The calcareous Clark soils are on knobs. Farnum and Shellabarger soils have a subsoil that is more clayey than that of the Albion soil. Farnum soils are in slightly concave areas, and Shellabarger soils are in the lower areas. Included soils make up about 20 percent of the map unit.

Permeability is moderately rapid in the upper part of the Albion soil and rapid in the substratum. Runoff is slow. Available water capacity and natural fertility are low. The surface layer is friable, and tilth is good.

About half of the acreage is used for cultivated crops, and the rest is used as range. Some areas have been reseeded to grass. This soil is moderately well suited to wheat and grain sorghum. It is better suited to small grain than to sorghum because of the low available water capacity. Water erosion and soil blowing are hazards if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and soil blowing and conserve moisture.

This soil is moderately well suited to irrigated alfalfa, wheat, and grain sorghum. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration. Efficient water management is needed.

Droughtiness is a limitation affecting the use of this soil as range. Water erosion and soil blowing are hazards if the range is overgrazed. They can be controlled by maintaining an adequate plant cover.

This soil is well suited to dwellings. It is poorly suited to onsite waste disposal. The sandy substratum does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of shallow ground water. Areas where the depth to sand is more than 40 inches are suitable sites for absorption fields. Seepage is a limitation on

Figure 7.—An area of Albion-Shellabarger sandy loams, 4 to 15 percent slopes, used as range.

sites for sewage lagoons. It can be controlled by sealing the lagoon. The so l is a probable source of sand and gravel.

The land capability classification is IIIe, dryland and irrigated, and the range site is Sandy.

As—Albion-Shellabarger sandy loams, 4 to 15 percent slopes. These deep, moderately sloping and strongly sloping soils are on uplands. The somewhat excessively drained Albion soil is on side slopes. The well drained Shellabarger soil is on ridges. Individual

areas are irregular in shape and range from 25 to several hundred acres in size. They are about 55 percent Albion soil and 30 percent Shellabarger soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Albion soil has a surface layer of brown sandy loam about 8 inches thick. The subsoil is about 20 inches thick. The upper part is strong brown, friable sandy loam, and the lower part is reddish yellow, very friable loamy sand. The substratum to a depth of about 60 inches is light yellowish brown sand.

Typically, the Shellabarger soil has a surface soil of brown sandy loam about 11 inches thick. The subsoil is friable sandy clay loam about 27 inches thick. The upper part is reddish brown, and the lower part is reddish yellow. The substratum to a depth of about 60 inches is reddish yellow, calcareous sandy loam. In places the depth to lime is less than 34 inches.

Included with these soils in mapping are small areas of Case, Clark, and Lincoln soils and soils that are gravelly loamy sand throughout. Case and Clark soils are calcareous throughout. They are on the steeper side slopes along drainageways. The sandy Lincoln soils are on flood plains. Included soils make up about 15 percent of the map unit.

Permeability is moderately rapid in the upper part of the Albion soil and rapid in the substratum. It is moderate in the Shellabarger soil. Runoff is slow on the Albion soil and medium on the Shellabarger soil. Available water capacity is low in the Albion soil and moderate in the Shellabarger soil. Natural fertility is low in the Albion soil and medium in the Shellabarger soil.

Nearly all areas are used as range (fig. 7). Because of a severe hazard of water erosion, these soils are generally unsuited to cultivated crops. They are better suited to range. Droughtiness is a concern in managing the Albion soil as range. Water erosion and soil blowing are hazards on both soils if the range is overgrazed. They can be controlled by maintaining an adequate plant cover.

These soils are moderately well suited to dwellings. Because of the slope, some land shaping commonly is needed.

The Albion soil is generally unsuited to onsite waste disposal. The sandy substratum does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of shallow ground water. Seepage and slope are limitations on sites for sewage lagoons. Because it is deeper over the underlying sandy material, the Shellabarger soil is a better site for waste disposal systems than the Albion soil. The slope, however, is a limitation. The less sloping areas should be selected as sites for disposal systems. Sealing the floor of sewage lagoons helps to control seepage. The Albion soil is a probable source of sand and gravel.

The land capability classification is VIe, dryland, and the range site is Sandy.

Bt—Buttermilk silt loam. This deep, nearly level, moderately well drained, saline soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 80 to a few hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 5 inches thick. The subsurface layer is dark grayish brown, calcareous silt loam about 23 inches thick. The subsoil is light brown, friable, calcareous silt loam about 16 inches thick. The subsurface layer and subsoil have fine white crystals. The substratum to a depth of about 60 inches is pink, calcareous silt loam.

Included with this soil in mapping are small areas of the nonsaline Dale soils. These soils make up about 20 percent of the map unit.

Permeability is moderate in the Buttermilk soil, and runoff is slow. Available water capacity is moderate. Natural fertility is medium. The shrink-swell potential is moderate in the subsoil. The surface layer is friable, and tilth is fair. A seasonal high water table is at a depth of 4.5 to 6.0 feet in winter and spring. The content of sodium and soluble salts in this soil adversely affects the growth of most plants.

About half of the acreage is used for cultivated crops, and half is used as range. This soil is moderately well suited to wheat and grain sorghum. The main limitation is the content of sodium and soluble salts (fig. 8). Minimizing tillage and leaving crop residue on the surface conserve moisture, help to maintain tilth, and increase the rate of water infiltration.

This soil is suited to range. The only suitable grass species, however, are those that are salt tolerant.

Because of the flooding, this soil is poorly suited to dwellings. It is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding, the wetness, and the moderate permeability are limitations on sites for septic tank absorption fields, and seepage and wetness are limitations on sites for sewage lagoons. Better suited soils can be selected as sites for these uses.

The land capability classification is IIIs, dryland, and the range site is Saline Lowland.

Ca—Canadian fine sandy loam. This deep, nearly level, well drained soil is on stream terraces. It is

Figure 8.—Wheat on Buttermilk silt loam. Growth is spotty because of salts in the soil.

subject to rare flooding. Areas are irregularly shaped or elongated and range from 10 to 200 acres in size.

Typically, the surface layer is brown fine sandy loam about 7 inches thick. The subsurface layer is dark grayish brown fine sandy loam about 10 inches thick. The subsoil is brown, very friable fine sandy loam about 10 inches thick. The substratum to a depth of about 60 inches is pale brown, calcareous sandy loam. In some areas the soil is loam throughout.

Included with this soil in mapping are small areas of the somewhat excessively drained Lincoln and somewhat poorly drained Waldeck soils on the slightly lower flood plains. These soils make up about 10 percent of the map unit.

Permeability is moderately rapid in the Canadian soil, and runoff is slow. Available water capacity is moderate. Natural fertility is medium. The surface layer is very friable, and tilth is good.

Most areas are used for cultivated crops. The rest are used as range. This soil is well suited to wheat and grain sorghum. Soil blowing is a hazard if cultivated crops are grown. Stubble mulch tillage, wind stripcropping, and minimum tillage help to control soil blowing and conserve moisture.

This soil is well suited to irrigated corn and grain sorghum. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration. Efficient water management is needed. Land leveling or contour furrowing reduces the runoff rate and improves water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

This soil is poorly suited to dwellings and septic tank absorption fields. It is generally unsuited to sewage lagoons because of seepage. The flooding is a hazard affecting building site development. Dikes, levees, and other flood-control structures may be needed. The higher parts of the landscape can be selected as building sites. The sandy substratum does not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of shallow ground water.

The land capability classification is IIe, dryland and irrigated, and the range site is Sandy Terrace.

Cc—Carey silt loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on uplands. Individual areas are irregular in shape and range from 40 to several hundred acres in size.

Typically, the surface layer is brown silt loam about 10 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil is about 19 inches thick. It is friable and calcareous. The upper part is brown loam, and the lower part is light brown clay loam. The substratum to a depth of about 60 inches is light reddish brown, calcareous loam. In some areas the surface layer is calcareous.

Included with this soil in mapping are small areas of the moderately deep Woodward soils on side slopes. These soils make up about 10 percent of the map unit.

Permeability is moderate in the Carey soil, and runoff is slow. Available water capacity is high. Natural fertility is medium. The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. Inadequate rainfall is the main management concern. Returning crop residue to the soil and minimizing tillage improve fertility and tilth and conserve moisture. Some areas receive moisture from the higher adjacent soils.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because of seepage. Sealing the lagoon helps to overcome this limitation.

The land capability classification is IIc, dryland, and the range site is Loamy Upland.

Cd—Carey silt loam, 2 to 5 percent slopes. This deep, gently sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is brown silt loam about 10 inches thick. The subsurface layer is brown loam about 5 inches thick. The subsoil is about 19 inches thick. It is friable and calcareous. The upper part is brown loam, and the lower part is light brown clay loam. The substratum to a depth of about 60 inches is light reddish brown, calcareous loam. In some areas the surface layer is calcareous.

Included with this soil in mapping are small areas of the shallow Quinlan and moderately deep Woodward soils on the lower side slopes. These soils make up about 15 percent of the map unit.

Permeability is moderate in the Carey soil, and runoff is medium. Available water capacity is high. Natural fertility is medium. The surface layer is friable, and tilth is good.

Most of the acreage is used for cultivated crops. A few areas are used as range. This soil is well suited to wheat and grain sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, leaving crop residue on the surface, and minimizing tillage help to control runoff and erosion and conserve moisture.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because of slope and seepage. Sealing the lagoon helps to control seepage. Some land shaping commonly is needed.

The land capability classification is IIIe, dryland, and the range site is Loamy Upland.

Ch—Case clay loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 20 to 160 acres in size.

Typically, the surface layer is brown, calcareous clay loam about 8 inches thick (fig. 9). The subsoil is friable, calcareous clay loam about 19 inches thick. It is yellowish brown in the upper part and light brown in the lower part. The substratum to a depth of about 60 inches is light brown, calcareous clay loam. In some areas the surface layer is dark grayish brown and is 10 to 15 inches thick.

Included with this soil in mapping are small areas of the noncalcareous Albion soils. These soils have a subsoil that is sandier than that of the Case soil. Also, they are on lower side slopes. They make up about 10 percent of the map unit.

Permeability is moderate in the Case soil, and runoff is medium. Available water capacity is high. Natural fertility is low. The surface layer is friable, and tilth is good. The shrink-swell potential is moderate in the subsoil.

Nearly all areas are used for cultivated crops. This soil is moderately well suited to wheat and grain sorghum. Water erosion is a hazard if cultivated crops

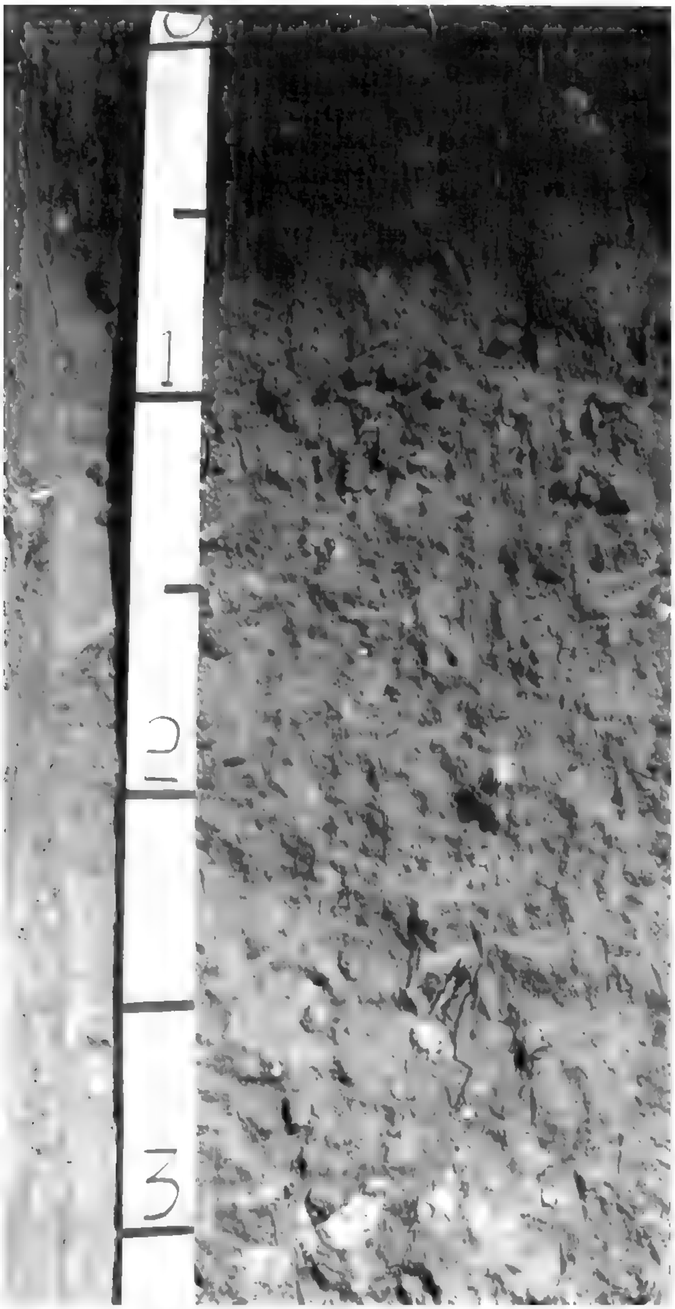

Figure 9.—Profile of Case clay loam, 1 to 3 percent slopes. This soil is calcareous throughout. Depth is marked in feet.

are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control erosion and conserve moisture. Sorghum is subject to iron chlorosis.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome, however, by enlarging the field. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIIe, dryland, and the range site is Limy Upland.

Ck—Case clay loam, 3 to 7 percent slopes. This deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 20 to 160 acres in size.

Typically, the surface layer is brown, calcareous clay loam about 8 inches thick. The subsoil is friable, calcareous clay loam about 19 inches thick. The upper part is yellowish brown, and the lower part is light brown. The substratum to a depth of about 60 inches is light brown, calcareous clay loam. In some areas the surface layer is dark grayish brown and is 10 to 15 inches thick.

Included with this soil in mapping are small areas of the noncalcareous Albion soils. These soils have a subsoil that is sandier than that of the Case soil. Also, they are on lower side slopes. They make up about 10 percent of the map unit.

Permeability is moderate in the Case soil, and runoff is medium. Available water capacity is high. Natural fertility is low. The surface layer is friable, and tilth is good. The shrink-swell potential is moderate in the subsoil.

Nearly all areas are used for cultivated crops. This soil is poorly suited to wheat and grain sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture. Sorghum is subject to iron chlorosis.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and

swelling. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome, however, by enlarging the field. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IVe, dryland, and the range site is Limy Upland.

Cm—Case clay loam, 7 to 15 percent slopes. This deep, strongly sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 30 to several hundred acres in size.

Typically, the surface layer is brown, calcareous clay loam about 8 inches thick. The subsoil is friable, calcareous clay loam about 19 inches thick. The upper part is yellowish brown, and the lower part is light brown. The substratum to a depth of about 60 inches is light brown, calcareous clay loam. In some areas the surface layer is dark grayish brown and is 10 to 15 inches thick. In other areas caliche bedrock is at a depth of 20 to 40 inches.

Included with this soil in mapping are small areas of Kingsdown soils; long, narrow areas of dark, calcareous, loamy alluvial soils along drainageways; and pockets of gravel. Kingsdown soils have a subsoil that is sandier than that of the Case soil. They are in positions on the landscape similar to those of the Case soil. The pockets of gravel are on the steeper slopes. Included soils make up about 15 percent of the map unit.

Permeability is moderate in the Case soil, and runoff is rapid. Available water capacity is high. Natural fertility is low. The shrink-swell potential is moderate in the subsoil.

Nearly all areas are used as range. Because of a severe hazard of water erosion, this soil is generally unsuited to cultivated crops. It is better suited to range. Water erosion and soil blowing are hazards in overgrazed areas. Gullies form along some cattle trails. Maintaining an adequate plant cover helps to control water erosion and soil blowing. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate.

This soil is moderately well suited to dwellings. The shrink-swell potential and the slope are limitations. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. Some land shaping commonly is needed to overcome the slope.

This soil is moderately well suited to septic tank absorption fields and is poorly suited to sewage lagoons. The slope is the main limitation. Also, the moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome, however, by enlarging the field. Because of the slope, the lateral lines should be installed on the contour. Some land shaping commonly is needed on sites for lagoons.

The land capability classification is VIe, dryland, and the range site is Limy Upland.

Co—Clairemont silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. Individual areas are long and narrow or are irregularly shaped. They range from 20 to 600 acres in size.

Typically, the surface soil is reddish brown silt loam about 13 inches thick. The upper part of the substratum is reddish brown, calcareous silty clay loam. The lower part to a depth of about 60 inches is red, calcareous silt loam.

Permeability is moderate, and runoff is slow. Available water capacity is high. Natural fertility is low. The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. The flooding is a hazard if cultivated crops are grown. Most floods are of short duration. In some years crop yields are reduced by the flooding, but in other years they are increased by the extra moisture. Planting and harvesting are delayed by the wetness in some years. Terraces, contour farming, and detention dams on the adjacent uplands can decrease the severity of the flooding. Minimizing tillage and leaving crop residue on the surface conserve moisture, help to maintain tilth, and increase the rate of water infiltration.

This soil is unsuited to building site development because of the flooding.

The land capability classification is IIw, dryland, and the range site is Loamy Lowland.

Cp—Clairemont loam, channeled. This deep, nearly level, well drained soil is on narrow flood plains dissected by meandering, intermittent streams. It is frequently flooded for very brief periods. Individual areas are long and narrow and range from 20 to 600 acres in size.

Typically, the surface layer is reddish brown loam about 8 inches thick. The subsurface layer is reddish

brown, calcareous loam about 7 inches thick. The substratum to a depth of about 60 inches is red, calcareous loam.

Included with this soil in mapping are small areas of the shallow Quinlan and moderately deep Woodward soils. These soils are in the steeper areas on uplands. They make up about 5 percent of the map unit.

Permeability is moderate in the Clairemont soil, and runoff is slow. Available water capacity is high. Natural fertility is low.

Nearly all areas are used as range. Because the flooding is a hazard and because operating farm machinery is difficult along the meandering stream channels, this soil is generally unsuited to cultivated crops. It is better suited to range. The flooding and the deposition and channeling caused by floodwater are problems affecting the use of this soil as range.

Some areas of this soil are suitable for the development of wildlife habitat. The areas of grass and trees adjacent to the streams provide excellent habitat for turkey, deer, and quail.

This soil is unsuited to building site development because of the flooding.

The land capability classification is Vw, dryland, and the range site is Loamy Lowland.

Cr—Clark clay loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on uplands. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous clay loam about 12 inches thick. The subsoil is brown and light yellowish brown, friable, calcareous clay loam about 14 inches thick. It has many concretions of lime in the lower part. The substratum to a depth of about 60 inches is very pale brown, calcareous clay loam. In some areas, the depth to calcareous material is more than 12 inches and the subsoil contains more clay than the surface layer.

Included with this soil in mapping are small areas of Farnum and Kingsdown soils. Farnum soils have a noncalcareous subsoil. They are in slightly concave areas. Kingsdown soils are more sandy than the Clark soil. They are on ridges. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Clark soil. Runoff is slow. Available water capacity is high, and natural fertility is medium. The shrink-swell potential is moderate throughout the soil. The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. Inadequate rainfall is the main limitation. Returning crop residue to the soil and minimizing tillage improve fertility and tilth and conserve moisture. Sorghum is subject to iron chlorosis.

This soil is well suited to irrigated corn and grain sorghum. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration. Efficient water management is needed. Land leveling or contour furrowing reduces the runoff rate and improves water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. Increasing the size of the absorption field helps to overcome this limitation. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIc, dryland, and I, irrigated. The range site is Limy Upland.

Cs—Clark clay loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on uplands. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous clay loam about 10 inches thick. The subsoil is friable, calcareous clay loam about 14 inches thick. The upper part is brown, and the lower part is light yellowish brown and has many concretions of lime. The substratum to a depth of about 60 inches is very pale brown, calcareous clay loam. In some areas the surface layer is noncalcareous. In other areas it is light brownish gray.

Included with this soil in mapping are small areas of Abilene, Farnum, and Holdrege soils. These soils are deeper to lime than the Clark soil. Also, they are higher on the landscape. They make up about 10 percent of the map unit.

Permeability is moderate in the Clark soil. Available water capacity is high. Natural fertility and runoff are medium. The shrink-swell potential is moderate throughout the soil. The surface layer is friable, and tilth is good.

Most areas are used for cultivated crops. Some are

used as range. This soil is moderately well suited to wheat and grain sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture. Sorghum is subject to iron chlorosis.

This soil is suited to range. Water erosion and soil blowing are hazards in overgrazed areas. Gullies form along some cattle trails. Maintaining an adequate plant cover helps to control water erosion and soil blowing. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome, however, by enlarging the field. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIIe, dryland, and the range site is Limy Upland.

Ct—Clark clay loam, 3 to 6 percent slopes. This deep, moderately sloping, well drained soil is on convex upland slopes, generally along intermittent drainageways. Individual areas are irregular in shape and range from 20 to 160 acres in size.

Typically, the surface layer is grayish brown, calcareous clay loam about 10 inches thick. The subsoil is brown and light yellowish brown, friable, calcareous clay loam about 14 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous clay loam. In some areas the surface layer is light brownish gray.

Included with this soil in mapping are small areas of Abilene and Farnum soils on the upper side slopes. These soils are deeper to lime than the Clark soil. They make up about 10 percent of the map unit.

Permeability is moderate in the Clark soil. Available water capacity is high. Natural fertility and runoff are medium. The shrink-swell potential is moderate throughout the soil. The surface layer is friable, and tilth is good.

About half of the acreage is used for cultivated crops, and the rest is used as range. This soil is poorly suited to wheat and grain sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture. Sorghum is subject to iron chlorosis.

This soil is suited to range. Water erosion and soil blowing are hazards in overgrazed areas. Gullies form along some cattle trails. Maintaining an adequate plant cover helps to control water erosion and soil blowing. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate.

This soil is moderately well suited to dwellings, septic tank absorption fields, and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. It can be overcome, however, by enlarging the field. Seepage and slope are limitations on sites for sewage lagoons. Sealing the lagoon helps to control seepage. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IVe, dryland, and the range site is Limy Upland.

Cw—Clark-Kingsdown complex, 5 to 12 percent slopes. These deep, moderately sloping and strongly sloping, well drained soils are on uplands. The Clark soil is on ridgetops and side slopes. The Kingsdown soil is on side slopes. It is less sloping than the Clark soil. Individual areas are irregular in shape and range from 20 to 1,000 acres in size. They are about 50 percent Clark soil and 30 percent Kingsdown soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Clark soil has a surface layer of dark grayish brown, calcareous clay loam about 8 inches thick. The subsoil is grayish brown and pale brown, friable, calcareous clay loam about 22 inches thick. It has many concretions of lime in the lower part. The substratum to a depth of about 60 inches is very pale brown, calcareous clay loam. In places the surface layer is light brownish gray.

Typically, the Kingsdown soil has a surface layer of grayish brown fine sandy loam about 10 inches thick. The subsoil is grayish brown, very friable, calcareous fine sandy loam about 17 inches thick. The substratum

to a depth of about 60 inches is pale brown, calcareous fine sandy loam. In some areas it is loamy fine sand.

Included with these soils in mapping are small areas of the noncalcareous Albion and Shellabarger soils and small areas of dark, calcareous, loamy alluvial soils. Albion soils are on knolls and on side slopes along some drainageways. Shellabarger soils are on ridges and the upper side slopes. The loamy alluvial soils are on occasionally flooded bottom land along drainageways. Included soils make up about 20 percent of the map unit.

Permeability is moderate in the Clark soil and moderately rapid in the Kingsdown soil. Runoff is rapid on the Clark soil and medium on the Kingsdown soil. Available water capacity is high in the Clark soil and moderate in the Kingsdown soil. Natural fertility is medium in both soils. The shrink-swell potential is moderate in the Clark soil.

Nearly all areas are used as range. Because of a severe hazard of erosion, this map unit is generally unsuited to cultivated crops. It is better suited to range. Water erosion and soil blowing are hazards in overgrazed areas. Gullies form along some cattle trails. Maintaining an adequate plant cover helps to control water erosion and soil blowing. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate.

The Clark soil is moderately well suited to dwellings and septic tank absorption fields. It is poorly suited to sewage lagoons because of the slope. The shrink-swell potential and the slope are limitations on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. Some land shaping commonly is needed. The moderate permeability restricts the absorption of effluent in septic tank absorption fields. Increasing the size of the field helps to overcome this limitation. Because of the slope, the lateral lines should be installed on the contour.

The Kingsdown soil is well suited to dwellings and septic tank absorption fields. It is poorly suited to sewage lagoons because of seepage. Sealing the lagoon helps to control seepage.

The land capability classification is VIe, dryland. The Clark soil is in the Limy Upland range site, and the Kingsdown soil is in the Sandy range site.

Dc—Dale silt loam. This deep, nearly level, well drained soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 40 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsurface layer is dark grayish brown silt loam about 16 inches thick. The subsoil is grayish brown, calcareous, firm silty clay loam about 13 inches thick. The substratum to a depth of about 60 inches is brown, calcareous silty clay loam. In some areas the soil contains more clay.

Permeability is moderate, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. The main management concern is inadequate rainfall. Minimizing tillage and leaving crop residue on the surface conserve moisture, help to maintain tilth, and increase the rate of water infiltration. Diversion terraces and ponds help to keep excess water from the adjacent uplands away from this soil.

This soil is poorly suited to dwellings because of the flooding. Dikes, levees, and similar structures lessen the flooding hazard. Onsite inspection and knowledge of an area's flooding history are needed when building sites are selected.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding is a hazard on sites for septic tank absorption fields. Levees reduce this hazard. The moderate permeability restricts the absorption of effluent from septic tanks. Increasing the size of the absorption field helps to overcome this limitation. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIc, dryland, and the range site is Loamy Terrace.

Ed—Elandco silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. Individual areas are long and narrow and range from 20 to 200 acres in size.

Typically, the surface layer is grayish brown silt loam about 6 inches thick. The subsurface layer is friable silt loam about 25 inches thick. It is dark grayish brown in the upper part and grayish brown in the lower part. The substratum to a depth of about 60 inches is grayish brown, calcareous silt loam. In some areas the surface layer is calcareous.

Permeability is moderate, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate throughout the soil. The surface layer is friable, and tilth is good.

Most areas are used for cultivated crops. This soil is

well suited to wheat and grain sorghum. The flooding is a hazard. Most floods are of short duration. In some years crop yields are reduced by floodwater, but in other years they are increased by the extra moisture. Planting and harvesting are delayed by wetness in some years. Terraces, contour farming, and detention dams on the adjacent uplands decrease the severity of the flooding. Minimizing tillage and leaving crop residue on the surface conserve moisture, help to maintain tilth, and increase the rate of water infiltration.

This soil is suited to range. No major problems affect the use of this soil as range.

This soil is unsuited to building site development because of the flooding.

The land capability classification is IIw, dryland, and the range site is Loamy Lowland.

Ef—Elandco silt loam, channeled. This deep, nearly level, well drained soil is on narrow flood plains dissected by meandering streams. It is frequently flooded for very brief periods. Individual areas are long and narrow and range from 40 to 400 acres in size.

Typically, the surface layer is dark grayish brown silt loam about 20 inches thick. The subsurface layer is grayish brown, friable silt loam about 11 inches thick. The substratum to a depth of about 60 inches is grayish brown, calcareous silt loam. In some areas the soil is loam throughout. In other areas it is calcareous throughout.

Included with this soil in mapping are small areas of the calcareous Case soils. These soils are in the steeper areas on uplands. They make up about 5 percent of the map unit.

Permeability is moderate in the Elandco soil, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate throughout the soil.

Nearly all areas are used as range. Because the flooding is a hazard and because operating farm machinery is difficult along the meandering stream channels, this soil is generally unsuited to cultivated crops. It is better suited to range. The flooding and the deposition and channeling caused by floodwater are problems affecting the use of this soil as range.

Some areas of this soil are suitable for the development of wildlife habitat. The areas of grass and trees adjacent to the streams provide excellent habitat for turkey, deer, and quail.

This soil is unsuited to building site development because of the flooding.

The land capability classification is Vw, dryland, and the range site is Loamy Lowland.

Fe—Farnum loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on flats in the uplands. Individual areas are irregular in shape and range from 20 to 500 acres in size.

Typically, the surface soil is grayish brown loam about 10 inches thick. The subsoil is firm clay loam about 44 inches thick. The upper part is dark grayish brown, the next part is grayish brown, and the lower part is pale brown and calcareous. The substratum to a depth of about 60 inches is pale brown, calcareous fine sandy loam. In some areas the subsoil is more clayey.

Permeability is moderate, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. Inadequate rainfall is the main management concern. Returning crop residue to the soil and minimizing tillage improve fertility and tilth and conserve moisture.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderate permeability restricts the absorption of effluent from septic tanks. Increasing the size of the absorption field and installing the lateral lines below the subsoil help to overcome this limitation. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIc, dryland, and the range site is Loamy Upland.

Ff—Farnum loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on ridges in the uplands. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface soil is grayish brown loam about 10 inches thick. The subsoil is firm clay loam about 44 inches thick. The upper part is dark grayish brown, the next part is grayish brown, and the lower part is pale brown and calcareous. The substratum to a depth of about 60 inches is pale brown, calcareous fine sandy loam. In some areas the subsoil is more clayey. In other areas the depth to lime is less than 36 inches.

Permeability is moderate, and runoff is medium. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil.

The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture.

This soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The moderate permeability somewhat restricts the absorption of effluent in septic tank absorption fields. Enlarging the absorption field helps to overcome this limitation. Seepage and slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIe, dryland, and the range site is Loamy Upland.

He—Hedville-Rock outcrop complex, 8 to 30 percent slopes. This map unit occurs as areas of a shallow, strongly sloping to steep, somewhat excessively drained Hedville soil intricately mixed with areas of Rock outcrop. The Hedville soil is on ridges and side slopes, and the Rock outcrop is on the steeper side slopes. The landscape is dissected by deeply entrenched drainageways. Individual areas are irregular in shape and range from 10 to 150 acres in size. They are about 60 percent Hedville soil and 20 percent Rock outcrop. The Hedville soil and Rock outcrop occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Hedville soil has a surface layer of brown fine sandy loam about 11 inches thick. The subsoil also is brown fine sandy loam. It is about 8 inches thick. Sandstone bedrock is at a depth of about 19 inches.

Typically, the Rock outcrop is hard sandstone.

Included with the Hedville soil and Rock outcrop in mapping are small areas of the moderately deep Lancaster soils and small areas of deep, loamy soils. Included soils are on ridges and the lower side slopes. They make up about 20 percent of the map unit.

Permeability is moderate in the Hedville soil, and runoff is rapid. Available water capacity is low. Natural fertility is low. Root penetration is restricted by the sandstone bedrock at a depth of about 19 inches.

Nearly all areas are used as range. This map unit is generally unsuited to cultivated crops. A severe hazard of water erosion is the main management concern. Also, operating tillage equipment is impractical because of the slope and the rockiness. The unit is better suited to range. Droughtiness and a shallow rooting depth are concerns in managing the Hedville soil as range. Because of the slope, water erosion is a hazard. Soil blowing is a hazard in overgrazed areas. Maintaining an adequate plant cover helps to control water erosion and soil blowing and conserves moisture. Reestablishing vegetation is difficult in denuded areas.

This map unit is unsuited to building site development because of the slope and the depth to bedrock.

The land capability classification is VIIs, dryland. The Hedville soil is in the Shallow Sandstone range site.

Hr—Holdrege silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on ridges in the uplands. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is grayish brown silt loam about 7 inches thick. The subsoil is silty clay loam about 22 inches thick. The upper part is grayish brown and firm, and the lower part is pale brown, friable, and calcareous. The upper part of the substratum is pale brown, calcareous silt loam. The lower part to a depth of about 60 inches is brown, calcareous loam. In some areas the subsoil is clay loam, silty clay, or silt loam.

Included with this soil in mapping are small areas of the calcareous Clark soils. These soils are on the lower side slopes. They make up about 5 percent of the map unit.

Permeability is moderate in the Holdrege soil, and runoff is medium. Available water capacity and natural fertility are high. The shrink-swell potential is moderate throughout the soil. The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum (fig. 10). Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture.

This soil is well suited to septic tank absorption fields. It is moderately well suited to dwellings and sewage lagoons. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around

Figure 10.—Baled forage sorghum on Holdrege silt loam, 1 to 3 percent slopes.

the foundations help to prevent the structural damage caused by shrinking and swelling. Seepage and slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIe, dryland, and the range site is Loamy Upland.

Kc—Kanza loamy fine sand, frequently flooded. This deep, nearly level, poorly drained soil is on flood plains. Individual areas are long and narrow or are irregularly shaped. They range from 30 to several hundred acres in size.

Typically, the surface layer is grayish brown loamy fine sand about 10 inches thick. The next layer is grayish brown, loose, mottled loamy fine sand about 10 inches thick. The substratum to a depth of about 60 inches is very pale brown, mottled sand. In some areas the part of the profile directly below the surface layer is fine sandy loam.

Included with this soil in mapping are small areas of the somewhat excessively drained Lincoln and somewhat poorly drained, loamy Waldeck and Zenda soils in the slightly higher positions on the landscape. These soils make up about 20 percent of the map unit.

Permeability is rapid in the Kanza soil, and runoff is slow. Available water capacity and natural fertility are low. A seasonal high water table is within a depth of 3 feet in the winter.

Nearly all areas are used as range. Because of the wetness and the frequent flooding, this soil is generally unsuited to cultivated crops. It is better suited to range. No major problems affect the use of this soil as range. The flooding and the wetness can be problems, however, in the spring.

This soil has fair potential for wetland wildlife habitat.

Excavated ponds provide habitat for waterfowl. The areas of grass and trees adjacent to the streams provide excellent habitat for turkey, deer, and quail.

This soil is unsuited to building site development because of the flooding and the wetness.

The land capability classification is Vw, dryland, and the range site is Subirrigated.

Kf—Kaski loam. This deep, nearly level, well drained soil is on stream terraces. It is subject to rare flooding. Individual areas are irregular in shape and range from 10 to 100 acres in size.

Typically, the surface soil is grayish brown loam about 22 inches thick. The subsoil is brown, friable clay loam about 15 inches thick. The substratum to a depth of about 60 inches is yellowish brown loam. In some areas the soil is fine sandy loam throughout.

Permeability is moderate, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the surface soil and subsoil. The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. The main management concern is inadequate rainfall. Minimizing tillage and leaving crop residue on the surface conserve moisture, help to maintain tilth, and increase the rate of water infiltration. Diversion terraces help to keep excess water from the adjacent uplands away from this soil.

This soil is poorly suited to dwellings because of the flooding. Dikes, levees, and similar structures lessen the flooding hazard. Onsite inspection and knowledge of an area's flooding history are needed when building sites are selected.

This soil is moderately well suited to septic tank absorption fields and sewage lagoons. The flooding is a hazard on sites for septic tank absorption fields. Levees reduce this hazard. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIc, dryland, and the range site is Loamy Terrace.

Kn—Kingsdown fine sandy loam, 0 to 2 percent slopes. This deep, nearly level, well drained soil is on uplands. Individual areas are irregular in shape and range from 10 to several hundred acres in size.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil is brown, calcareous, very friable fine sandy loam about 14 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, calcareous fine sandy loam. In some areas the subsoil is loamy fine sand. In other areas the depth to calcareous material is more than 15 inches.

Included with this soil in mapping are small areas of Clark soils on the lower parts of the landscape. These soils are more clayey than the Kingsdown soil. They make up about 10 percent of the map unit.

Permeability is moderately rapid in the Kingsdown soil, and runoff is slow. Available water capacity is moderate. Natural fertility is medium. The surface layer is very friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. Soil blowing is a hazard if cultivated crops are grown. Stubble mulch tillage, minimum tillage, and wind stripcropping help to control soil blowing and conserve moisture.

This soil is well suited to irrigated corn and grain sorghum. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration. Efficient water management is needed. Land leveling or contour furrowing reduces the runoff rate and improves water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

This soil is well suited to dwellings and septic tank absorption fields. It is poorly suited to sewage lagoons because of seepage. Sealing the lagoon helps to control seepage.

The land capability classification is IIe, dryland and irrigated, and the range site is Sandy.

Ko—Kingsdown fine sandy loam, 2 to 5 percent slopes. This deep, gently sloping, well drained soil is on uplands. Individual areas are irregular in shape and range from about 10 to 100 acres in size.

Typically, the surface layer is brown fine sandy loam about 10 inches thick. The subsoil is brown, very friable, calcareous fine sandy loam about 14 inches thick. The substratum to a depth of about 60 inches is light yellowish brown, calcareous fine sandy loam. In some areas the subsoil is loamy fine sand. In other areas the depth to calcareous material is more than 15 inches.

Included with this soil in mapping are small areas of Clark soils on the lower parts of the landscape. These soils are more clayey than the Kingsdown soil. They make up about 10 percent of the map unit.

Permeability is moderately rapid in the Kingsdown soil, and runoff is slow. Available water capacity is moderate. Natural fertility is medium. The surface layer is very friable, and tilth is good.

Most areas are used for cultivated crops. The rest are used as range. This soil is moderately well suited to wheat and grain sorghum. Soil blowing and water erosion are hazards if cultivated crops are grown. Stubble mulch tillage, minimum tillage, and wind stripcropping help to control soil blowing and conserve moisture. Terraces and contour farming, which are feasible in some areas, can help to control water erosion.

This soil is moderately well suited to irrigated corn and grain sorghum. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration. Efficient water management is needed. Land leveling or contour furrowing reduces the runoff rate and improves water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

This soil is suited to range. Soil blowing is a hazard if the range is overgrazed. It can be controlled by maintaining an adequate plant cover.

This soil is well suited to dwellings and septic tank absorption fields. It is poorly suited to sewage lagoons because of seepage. Sealing the lagoon helps to control seepage.

The land capability classification is IIIe, dryland and irrigated, and the range site is Sandy.

Kr—Krier loam. This deep, nearly level, somewhat poorly drained soil is on flood plains and low stream terraces. It is occasionally flooded for very brief periods. Individual areas are long and narrow or are irregularly shaped. They range from 20 to several hundred acres in size.

Typically, the surface layer is grayish brown, calcareous loam about 4 inches thick. The substratum to a depth of about 60 inches is calcareous and mottled. The upper part is light brownish gray loam, the next part is light brownish gray sandy loam, and the lower part is very pale brown sand. In some areas the depth to sand is more than 20 inches.

Included with this soil in mapping are small areas of the somewhat excessively drained Lincoln soils on the slightly higher parts of the landscape. These soils make up about 10 percent of the map unit.

Permeability is rapid in the Krier soil, and runoff is slow. Available water capacity and natural fertility are low. A seasonal high water table is at a depth of 1 to 3 feet in winter and spring. The content of sodium and soluble salts in this soil adversely affects the growth of most plants.

Nearly all areas are used as range. Because of the saline-alkali condition and the low available water capacity, this soil is generally unsuited to cultivated crops. It is better suited to range. Droughtiness is a concern in managing the soil as range. The content of sodium and soluble salts and the flooding also are management concerns. Salt-tolerant species are the best suited range plants.

Some areas of this soil are suitable for the development of wildlife habitat. The areas of grass and trees adjacent to the streams provide excellent habitat for turkey, deer, and quail.

This soil is unsuited to building site development because of the flooding and the wetness.

The land capability classification is VIs, dryland, and the range site is Saline Subirrigated.

Ld—Lancaster-Hedville fine sandy loams, 4 to 12 percent slopes. These moderately sloping and strongly sloping soils are on uplands. The moderately deep, well drained Lancaster soil is on ridges and the lower side slopes. The shallow, somewhat excessively drained Hedville soil is on the steeper, upper side slopes. Individual areas are irregular in shape and range from 30 to several hundred acres in size. They are about 60 percent Lancaster soil and 25 percent Hedville soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Lancaster soil has a surface layer of brown fine sandy loam about 10 inches thick. The subsoil is about 21 inches thick. The upper part is brown, friable fine sandy loam; the next part is brown, friable sandy clay loam; and the lower part is reddish yellow, very friable sandy loam. Weathered sandstone bedrock is at a depth of about 31 inches. In some areas the depth to sandstone is more than 40 inches. In other areas the subsoil is fine sandy loam.

Typically, the Hedville soil has a surface layer of brown fine sandy loam about 11 inches thick. The subsoil also is brown fine sandy loam. It is about 8 inches thick. Hard sandstone bedrock is at a depth of about 19 inches.

Included with these soils in mapping are small areas of the clayey Wellsford soils on the higher parts of the landscape. These included soils make up about 15 percent of the map unit.

Permeability is moderate in the Hedville and Lancaster soils, and runoff is rapid. Available water capacity is low. Natural fertility is medium in the Lancaster soil and low in the Hedville soil. The shrink-swell potential is moderate in the subsoil of the Lancaster soil. Root penetration is restricted by the sandstone bedrock at a depth of about 31 inches in the Lancaster soil and 19 inches in the Hedville soil.

Nearly all areas are used as range. Because of a severe hazard of water erosion, these soils are generally unsuited to cultivated crops. They are better suited to range. Droughtiness is a concern in managing the soils as range. Because of the slope, water erosion is a hazard unless an adequate plant cover is maintained. Soil blowing is a hazard in overgrazed areas. Gullies form along some cattle trails. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate. Reestablishing vegetation is difficult in denuded areas.

The Hedville soil is generally unsuited to building site development because of the depth to bedrock.

The Lancaster soil is moderately well suited to dwellings. The shrink-swell potential is a limitation. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling.

Because of seepage and slope, the Lancaster soil is poorly suited to septic tank absorption fields and sewage lagoons. The deeper, less sloping soils on the lower side slopes are better suited to onsite sewage disposal systems.

The land capability classification is VIe, dryland. The Lancaster soil is in the Loamy Upland range site, and the Hedville soil is in the Shallow Sandstone range site.

Le—Lesho clay loam, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains. Individual areas are irregular in shape and range from 10 to 160 acres in size.

Typically, the surface layer is grayish brown, calcareous clay loam about 10 inches thick. The subsurface layer also is grayish brown, calcareous clay loam. It is about 8 inches thick. The upper part of the substratum is brown, calcareous, mottled clay loam. The lower part to a depth of about 60 inches is very pale brown, calcareous sand. In some areas the depth to sand is more than 40 inches. In other areas the surface soil is thinner.

Included with this soil in mapping are small areas of Lincoln and Waldeck soils. These soils are more sandy than the Lesho soil. They are in positions on the landscape similar to those of the Lesho soil. They make up about 20 percent of the map unit.

Permeability is moderately slow in the upper part of the Lesho soil and moderately rapid or rapid in the lower part. Runoff is slow. Available water capacity is moderate. Natural fertility is medium. A seasonal high water table is at a depth of 2 to 4 feet in spring and early summer. The shrink-swell potential is moderate in the upper part of the soil. The surface layer is friable, and tilth is good.

Most areas are used as range. Some are used for cultivated crops. This soil is moderately well suited to wheat and grain sorghum. The flooding and the wetness are the main management concerns. Dikes, levees, and similar structures help to control floodwater.

This soil is suited to range. The flooding and the wetness can be problems in the spring. Trampling by livestock is likely to damage the turf if the range is grazed during wet periods.

Some areas of this soil are suitable for the development of wildlife habitat. The areas of grass and trees adjacent to the streams provide excellent habitat for turkey, deer, and quail.

This soil is unsuited to building site development because of the flooding and the wetness.

The land capability classification is IIIw, dryland, and the range site is Subirrigated.

Ln—Lincoln loamy sand, occasionally flooded. This deep, nearly level, somewhat excessively drained soil is on flood plains. Individual areas are long and narrow and range from 20 to several hundred acres in size.

Typically, the surface layer is brown, calcareous loamy sand about 10 inches thick. The next layer is light yellowish brown, calcareous, loose loamy sand about 12 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous sand. In some areas it is coarse sand or gravelly sand. In other areas the soil is noncalcareous throughout.

Included with this soil in mapping are small areas of the poorly drained Kanza and somewhat poorly drained Waldeck soils in the slightly lower positions on the landscape. These soils make up about 10 percent of the map unit.

Permeability is rapid in the Lincoln soil, and runoff is slow. Available water capacity and natural fertility are low. A seasonal high water table is at a depth of 5 to 8 feet in winter and spring.

Nearly all areas are used as range. Because of the low fertility, droughtiness, and flooding, this soil generally is unsuited to cultivated crops. It is better suited to range. The droughtiness and the hazard of flooding are concerns in managing the soil as range. Floodwater occasionally causes scouring and deposits sand and silt on the surface. Soil blowing is a hazard unless an adequate plant cover is maintained.

Some areas of this soil are suitable for the

development of wildlife habitat. The areas of grass and trees adjacent to the streams provide excellent habitat for turkey, deer, and quail.

This soil is unsuited to building site development because of the flooding.

The land capability classification is VIw, dryland, and the range site is Sandy Lowland.

Lo—Lincoln sandy loam, occasionally flooded. This deep, nearly level, somewhat excessively drained soil is on flood plains. Individual areas are irregular in shape and range from 35 to 100 acres in size.

Typically, the surface layer is pale brown sandy loam about 12 inches thick. The substratum to a depth of about 60 inches is reddish yellow, calcareous fine sand. In some areas the soil has a substratum of coarse sand or gravelly sand and a surface layer of loamy sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Waldeck soils. These soils are in positions on the landscape similar to those of the Lincoln soil. They make up about 10 percent of the map unit.

Permeability is rapid in the Lincoln soil, and runoff is slow. Available water capacity and natural fertility are low. A seasonal high water table is at a depth of 5 to 8 feet in winter and spring.

Nearly all areas are used as range. Because of droughtiness and the flooding, this soil is generally unsuited to cultivated crops. It is better suited to range. The droughtiness and the flooding are concerns in managing the soil as range. Floodwater occasionally causes scouring and deposits sand and silt on the surface. Water erosion and soil blowing are hazards unless an adequate plant cover is maintained.

This soil is unsuited to building site development because of the flooding.

The land capability classification is VIw, dryland, and the range site is Sandy Lowland.

Lr—Lincoln-Krier complex, occasionally flooded. These deep, nearly level soils are on flood plains. The somewhat excessively drained Lincoln soil is slightly higher on the landscape than the somewhat poorly drained, saline-alkali Krier soil. Individual areas are irregular in shape and range from 30 to 200 acres in size. They are about 60 percent Lincoln soil and 25 percent Krier soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Lincoln soil has a surface layer of grayish brown loamy sand about 8 inches thick. The substratum to a depth of about 60 inches is very pale brown, calcareous fine sand.

Typically, the Krier soil has a surface layer of grayish brown, calcareous loam about 4 inches thick. The substratum to a depth of about 60 inches is calcareous and mottled. The upper part is grayish brown loam, the next part is brown loamy sand, and the lower part is pale brown sand.

Included with these soils in mapping are small areas of Lesho and Waldeck soils. These included soils are more than 20 inches deep over sandy sediments. They are in positions on the landscape similar to those of the Lincoln and Krier soils. They make up about 15 percent of the map unit.

Permeability is rapid in the Lincoln and Krier soils, and runoff is slow. Available water capacity and natural fertility are low. In winter and spring, a seasonal high water table is at a depth of 5 to 8 feet in the Lincoln soil and 1 to 3 feet in the Krier soil. The content of sodium and soluble salts in the Krier soil restricts the growth of most plants.

Nearly all areas are used as range. Because of the low available water capacity and low fertility in both soils and the saline-alkali condition in the Krier soil, these soils are generally unsuited to cultivated crops. They are better suited to range. Droughtiness is a concern in managing the soils as range. The content of sodium and soluble salts in the Krier soil and the flooding on both soils also are management concerns.

These soils are unsuited to building site development because of the flooding. The wetness of the Krier soil also is a limitation.

The land capability classification is VIw, dryland. The Lincoln soil is in the Sandy Lowland range site, and the Krier soil is in the Saline Subirrigated range site.

Oa—Obaro silty clay loam, 5 to 12 percent slopes. This moderately deep, moderately sloping and strongly sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 20 to 600 acres in size.

Typically, the surface layer is reddish brown silty clay loam about 7 inches thick. The subsoil is reddish brown, calcareous silty clay loam about 28 inches thick. It is friable in the upper part and firm in the lower part. Fine grained sandstone is at a depth of about 35 inches. In some areas the depth to sandstone is more than 40 inches. In other areas it is less than 20 inches.

Included with this soil in mapping are small areas of gypsum outcrop. These areas make up about 5 percent of the map unit.

Permeability is moderate in the Obaro soil, and runoff is rapid. Available water capacity and natural fertility are

low. Root penetration is restricted by the sandstone bedrock at a depth of about 35 inches.

Nearly all areas are used as range. Because of a severe hazard of water erosion, this soil is generally unsuited to cultivated crops. It is better suited to range. Droughtiness is a concern in managing the soil as range. Because of the slope, water erosion is a hazard unless an adequate plant cover is maintained. Gullies form along some cattle trails. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate. Establishing vegetation is difficult in denuded areas.

Because of seepage, this soil is generally unsuited to septic tank absorption fields. It is poorly suited to sewage lagoons and moderately well suited to dwellings. Because the slope is a limitation, some land shaping commonly is needed on sites for dwellings and sewage lagoons. Seepage is an additional limitation on sites for lagoons. It can be controlled by sealing the lagoon.

The land capability classification is VIe, dryland, and the range site is Loamy Upland.

Ob—Obaro-Rock outcrop complex, 10 to 30 percent slopes. This map unit occurs as areas of a moderately deep, strongly sloping, well drained Obaro soil intricately mixed with areas of Rock outcrop. The Obaro soil is on ridges and side slopes, and the Rock outcrop is on knolls and the steeper side slopes. The landscape is dissected by deeply entrenched drainageways. Individual areas are irregular in shape and range from 10 to 300 acres in size. They are about 65 percent Obaro soil and 25 percent Rock outcrop. The Obaro soil and Rock outcrop occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Obaro soil has a surface layer of reddish brown silty clay loam about 7 inches thick. The subsoil is reddish brown, firm, calcareous silty clay loam about 28 inches thick. Fine grained sandstone bedrock is at a depth of about 35 inches. In some areas the depth to sandstone is more than 40 inches. In other areas the bedrock is hard gypsum.

Typically, the Rock outcrop is hard, massive gypsum.

Included with the Obaro soil and Rock outcrop in mapping are small areas of Clairemont soils on flood plains. These soils make up about 10 percent of the map unit.

Permeability is moderate in the Obaro soil, and runoff is rapid. Available water capacity and natural fertility are low. Root penetration is restricted by the sandstone bedrock at a depth of about 35 inches.

Nearly all areas are used as range. This map unit is generally unsuited to cultivated crops. A severe hazard of water erosion is the main management concern. Also, operating tillage equipment is impractical because of the slope and the rockiness. The unit is better suited to range. Droughtiness and a moderate rooting depth are concerns in managing the Obaro soil as range. Because of the slope, water erosion is a hazard unless an adequate plant cover is maintained. Gullies form along some cattle trails. Reestablishing vegetation is difficult in gullied or denuded areas. Fencing and other means of controlling livestock traffic patterns help to prevent gullying.

The Obaro soil is moderately well suited to dwellings. The slope is a limitation. It can be overcome by land shaping. The soil is generally unsuited to onsite waste disposal because of the slope and seepage.

The land capability classification is VIIs, dryland. The Obaro soil is in the Loamy Upland range site.

Oc—Ost clay loam, 2 to 6 percent slopes. This deep, gently sloping and moderately sloping, well drained soil is on ridges in the uplands. Individual areas are irregular in shape and range from 20 to 200 acres in size.

Typically, the surface layer is dark grayish brown clay loam about 8 inches thick. The subsoil is clay loam about 32 inches thick. The upper part is brown and firm; the next part is reddish brown, firm, and calcareous; and the lower part is reddish brown, friable, and calcareous. The substratum to a depth of about 60 inches is reddish yellow, calcareous clay loam. In places the depth to lime is less than 12 inches.

Included with this soil in mapping are small areas of Case soils on the lower side slopes. These soils are calcareous throughout. They have a surface layer that is lighter colored or thinner than that of the Ost soil. They make up about 5 percent of the map unit.

Permeability is moderately slow in the Ost soil, and runoff is medium. Available water capacity is high, and natural fertility is medium. The shrink-swell potential is moderate in the upper part of the subsoil. The surface layer is friable, and tilth is good.

More than half of the acreage is used as range. The rest is used for cultivated crops. This soil is moderately well suited to wheat and grain sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture.

This soil is suited to range. Water erosion is a hazard in overgrazed areas. In places gullies form along cattle

trails. Maintaining an adequate plant cover helps to control water erosion. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate.

This soil is well suited to dwellings and moderately well suited to sewage lagoons. It is poorly suited to septic tank absorption fields. The moderately slow permeability restricts the absorption of effluent in septic tank absorption fields. Increasing the size of the absorption field or installing the lateral lines below the subsoil helps to overcome this limitation. The slope is a limitation on sites for sewage lagoons. Some land shaping commonly is needed.

The land capability classification is IIIe, dryland, and the range s te is Loamy Upland.

Ph—Port silt loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. Individual areas are irregular in shape and range from 40 to several hundred acres in size.

Typically, the surface layer is dark reddish gray silt loam about 10 inches thick. The subsurface layer is reddish brown silty clay loam about 13 inches thick. The subsoil is reddish brown, friable, calcareous silty clay loam about 11 inches thick. The substratum to a depth of about 60 inches is red, calcareous silty clay loam. In some areas the surface layer is calcareous.

Included with this soil in mapping are small areas of Clairemont soils. These soils are in positions on the landscape similar to those of the Port soil. They have a surface layer that is lighter colored than that of the Port soil. They make up about 5 percent of the map unit.

Permeability is moderate in the Port soil, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. The surface layer is friable, and tilth is good.

Most areas are used for cultivated crops. A few are used as range. This soil is well suited to wheat and grain sorghum. The flooding is a hazard if cultivated crops are grown. Most floods are of short duration. Planting and harvesting are delayed by wetness in some years. Terraces, contour farming, and detention dams on the adjacent uplands can decrease the severity of flooding. Minimizing tillage and leaving crop residue on the surface conserve moisture, help to maintain tilth, and increase the rate of water infiltration.

This soil is suited to range. It receives extra moisture because of runoff from the higher adjacent areas. No major problems affect the use of this soil as range.

This soil is generally unsuited to building site development because of the flooding.

The land capability classification is IIw, dryland, and the range site is Loamy Lowland.

Po—Pratt loamy fine sand, rolling. This deep, well drained soil is on uplands. Individual areas are irregular in shape and range from 25 to several hundred acres in size.

Typically, the surface layer is brown loamy fine sand about 9 inches thick. The subsoil is brown, very friable loamy fine sand about 22 inches thick. The substratum to a depth of about 60 inches is reddish yellow loamy fine sand. In a few areas the subsoil is fine sandy loam.

Permeability is rapid, and runoff is slow. Available water capacity and natural fertility are low. The surface layer is very friable, and tilth is good.

Most areas are used as range. Some are used for cultivated crops. This soil is poorly suited to wheat and grain sorghum. Soil blowing is a hazard if cultivated crops are grown. It can be contro led by stubble mulch tillage, wind stripcropping, and minimum tillage.

This soil is suited to range. Droughtiness is a limitation. Also, soil blowing is a hazard if the range is overgrazed. It can be controlled by maintaining an adequate plant cover.

This soil is well suited to dwellings. Because of seepage, it is generally unsuited to sewage lagoons. It is poorly suited to septic tank absorption fields because the sandy substratum does not adequately filter the effluent. The poor filtering capacity may result in the pollution of shallow ground water. The areas where the subsoil is fine sandy loam are better sites for sanitary facilities.

The land capability classification is IVe, dryland, and the range site is Sands.

Pr—Pratt loamy fine sand, undulating. This deep, well drained soil is on uplands. Individual areas are irregular in shape and range from 30 to several hundred acres in size.

Typically, the surface layer is brown loamy fine sand about 9 inches thick. The subsoil is brown, very friable loamy fine sand about 22 inches thick. The substratum to a depth of about 60 inches is reddish yellow loamy fine sand. In some areas the subsoil is fine sandy loam. In other areas the soil is calcareous below a depth of 6 inches.

Permeability is rapid, and runoff is slow. Available water capacity and natural fertility are low. The surface layer is very friable, and tilth is good.

About half of the acreage is cultivated, and half is range. This soil is moderately well suited to wheat and

grain sorghum. Soil blowing is a hazard if cultivated crops are grown. It can be controlled by stubble mulch tillage, wind stripcropping, and minimum tillage.

This soil is moderately well suited to irrigated corn and grain sorghum. A sprinkler system is used in all irrigated areas. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration. Efficient water management is needed.

This soil is suited to range. Droughtiness is a limitation. Also, soil blowing is a hazard if the range is overgrazed. It can be controlled by maintaining an adequate plant cover.

This soil is well suited to dwellings. Because of seepage and a poor filtering capacity, however, it is generally unsuited to sewage lagoons and is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent from septic tanks. The poor filtering capacity may result in the pollution of shallow ground water. The areas where the subsoil is fine sandy loam are better sites for sanitary facilities.

The land capability classification is IIIe, dryland and irrigated, and the range site is Sands.

Pt—Pratt-Tivoli loamy fine sands, rolling. These deep soils are on uplands. The well drained Pratt soil is on the lower side slopes. The excessively drained Tivoli soil is on the crest of knolls and on the upper slopes. Individual areas are irregular in shape and range from 40 to several hundred acres in size. They are about 70 percent Pratt soil and 30 percent Tivoli soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Pratt soil has a surface layer of brown loamy fine sand about 9 inches thick. The subsoil is brown, very friable loamy fine sand about 22 inches thick. The substratum to a depth of about 60 inches is reddish yellow loamy fine sand. In a few areas the subsoil is fine sandy loam.

Typically, the Tivoli soil has a surface layer of brown loamy fine sand about 7 inches thick. The substratum to a depth of about 60 inches is yellow fine sand.

Permeability is rapid in both soils. Runoff is slow on the Pratt soil and very slow on the Tivoli soil. Available water capacity and natural fertility are low in both soils.

Nearly all areas are used as range. Because of a severe hazard of soil blowing, these soils are generally unsuited to cultivated crops. They are better suited to range. Droughtiness is a limitation. Also, soil blowing is a hazard if the range is overgrazed. It can be controlled by maintaining an adequate plant cover.

The Pratt soil has fair potential for rangeland wildlife habitat, but the Tivoli soil has poor potential. Lesser prairie chickens often inhabit the areas where the range is in good or excellent condition.

These soils are moderately well suited to dwellings. They are generally unsuited to sewage lagoons because of seepage. They are poorly suited to septic tank absorption fields. The slope is a limitation on sites for dwellings. As a result, some land shaping commonly is needed. The soils readily absorb but do not adequately filter the effluent in septic tank absorption fields. The poor filtering capacity may result in the pollution of shallow ground water. The areas where the subsoil is fine sandy loam are better sites for sanitary facilities.

The land capability classification is VIe, dryland, and the range site is Sands.

Qr—Quinlan-Woodward loams, 6 to 15 percent slopes. These strongly sloping, well drained soils are on uplands. The shallow Quinlan soil is on the steeper, upper side slopes. The moderately deep Woodward soil is on ridges and the lower side slopes. Individual areas are irregular in shape and range from 20 to several hundred acres in size. They are about 45 percent Quinlan soil and 35 percent Woodward soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Quinlan soil has a surface layer of yellowish red, calcareous loam about 7 inches thick. The subsoil is red, friable, calcareous loam about 7 inches thick. Weakly cemented, calcareous sandstone bedrock is at a depth of about 14 inches.

Typically, the Woodward soil has a surface layer of reddish brown loam about 7 inches thick. The subsoil is friable, calcareous loam about 23 inches thick. The upper part is reddish brown, and the lower part is red. Weakly cemented, calcareous sandstone bedrock is at a depth of about 30 inches.

Included with these soils in mapping are small areas of Carey soils, Rock outcrop, and very steep breaks. The deep Carey soils are in the less sloping areas. The Rock outcrop is in the steeper areas. The breaks are the nearly vertical sides of ravines. Included areas make up about 20 percent of the map unit.

Permeability is moderate in the Quinlan and Woodward soils, and runoff is rapid. Available water capacity is very low in the Quinlan soil and low in the Woodward soil. Natural fertility is low in both soils. Root penetration is restricted by the sandstone bedrock at a depth of about 14 inches in the Quinlan soil and 30 inches in the Woodward soil.

Nearly all areas are used as range. Because of a severe hazard of water erosion, these soils are generally unsuited to cultivated crops. They are better suited to range. Droughtiness is a concern in managing these soils as range. Also, water erosion and soil blowing are hazards unless an adequate plant cover is maintained. Gullies form along some cattle trails. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate. Establishing vegetation is difficult in denuded areas.

These soils are moderately well suited to dwellings. Because of the slope, some land shaping commonly is needed. The soils are generally unsuited to septic tank absorption fields and sewage lagoons because of seepage. The deep included soils are better sites.

The land capability classification is VIe, dryland. The Quinlan soil is in the Shallow Prairie range site, and the Woodward soil is in the Loamy Upland range site.

Qt—Quinlan-Woodward loams, 15 to 30 percent slopes. These moderately steep and steep, well drained soils are on uplands. The shallow Quinlan soil is on the steeper, upper side slopes. The moderately deep Woodward soil is on ridges and the lower side slopes. Individual areas are long and narrow and range from 20 to several hundred acres in size. They are about 60 percent Quinlan soil and 30 percent Woodward soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Quinlan soil has a surface layer of yellowish red, calcareous loam about 7 inches thick. The subsoil is red, friable, calcareous loam about 7 inches thick. Weakly cemented, calcareous sandstone bedrock is at a depth of about 14 inches. In places the depth to sandstone is less than 10 inches.

Typically, the Woodward soil has a surface layer of reddish brown loam about 7 inches thick. The subsoil is friable, calcareous loam about 23 inches thick. The upper part is reddish brown, and the lower part is red. Weakly cemented, calcareous sandstone bedrock is at a depth of about 30 inches. In places the depth to sandstone is more than 40 inches.

Included with these soils in mapping are small areas of Rock outcrop, very steep breaks, and nearly level, loamy, calcareous soils that formed in alluvium. The Rock outcrop is in the steeper areas. The breaks are the nearly vertical sides of ravines. The soils that formed in alluvium are on flood plains. Included areas make up about 10 percent of the map unit.

Permeability is moderate in the Quinlan and Woodward soils, and runoff is rapid. Available water capacity is very low in the Quinlan soil and low in the Woodward soil. Natural fertility is low in both soils. Root penetration is restricted by the sandstone bedrock at a depth of about 14 inches in the Quinlan soil and 30 inches in the Woodward soil.

Nearly all areas are used as range. Because of a very severe hazard of water erosion and the slope, these soils are generally unsuited to cultivated crops. They are better suited to range. Droughtiness is a concern in managing these soils as range. Water erosion and soil blowing are hazards unless an adequate plant cover is maintained. Gullies form along some cattle trails. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and give gullies time to revegetate. Establishing vegetation is difficult in denuded areas.

These soils are generally unsuited to building site development because of the slope. Seepage also is a limitation on sites for sanitary facilities.

The land capability classification is VIIe, dryland. The Quinlan soil is in the Shallow Prairie range site, and the Woodward soil is in the Loamy Upland range site.

Sb—St. Paul silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on flats in the uplands. Individual areas are irregular in shape and range from 30 to several hundred acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is friable silty clay loam about 32 inches thick. The upper part is brown, the next part is reddish brown, and the lower part is reddish brown and calcareous. The substratum to a depth of about 60 inches is yellowish red, calcareous silt loam. In some areas the subsoil is silty clay.

Permeability is moderately slow, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. Inadequate rainfall is the main management concern. Returning crop residue to the soil and minimizing tillage improve fertility and tilth and conserve moisture.

This soil is moderately well suited to dwellings and sewage lagoons. It is poorly suited to septic tank absorption fields. The moderate shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. The

Figure 11.—Plowed-up terraces on St. Paul silt loam, 1 to 3 percent slopes.

moderately slow permeability restricts the absorption of effluent in septic tank absorption fields. Increasing the size of the absorption field or installing the lateral lines below the subsoil helps to overcome this limitation. Seepage is a limitation on sites for sewage lagoons. It can be controlled by sealing the lagoon.

The land capability classification is IIc, dryland, and the range site is Loamy Upland.

Sc—St. Paul silt loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on ridges in the uplands. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface layer is brown silt loam about 8 inches thick. The subsoil is friable silty clay loam about 32 inches thick. The upper part is brown, the next part is reddish brown, and the lower part is reddish brown and calcareous. The substratum to a depth of about 60 inches is yellowish red, calcareous silt loam. In some areas the subsoil is silty clay.

Included with this soil in mapping are small areas of the moderately deep Woodward soils on the lower side slopes. These soils make up about 5 percent of the map unit.

Permeability is moderately slow in the St. Paul soil, and runoff is medium. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. Water erosion is a hazard if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture (fig. 11).

This soil is moderately well suited to dwellings and sewage lagoons. It is poorly suited to septic tank absorption fields. The moderate shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. The moderately slow permeability restricts the absorption of effluent in septic tank absorption fields. Increasing the size of the absorption field or installing the lateral lines below the subsoil helps to overcome this limitation. Seepage and slope are limitations on sites for sewage lagoons. Seepage can be controlled by sealing the lagoon. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIe, dryland, and the range site is Loamy Upland.

Sg—Shellabarger sandy loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on flats in the uplands. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface soil is brown sandy loam about 11 inches thick. The subsoil is friable sandy clay loam about 27 inches thick. It is reddish brown in the upper part and reddish yellow in the lower part. The substratum to a depth of about 60 inches is reddish yellow, calcareous sandy loam. In some areas the subsoil is clay loam.

Permeability is moderate, and runoff is slow. Available water capacity is moderate, and natural fertility is medium. The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. Soil blowing is a hazard if cultivated crops are grown. Stubble mulch tillage, minimum tillage, and wind stripcropping help to control soil blowing and conserve moisture.

This soil is well suited to irrigated corn and grain sorghum. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration. Efficient water management is needed. Land leveling or contour furrowing reduces the runoff rate and improves water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because seepage is a limitation. Sealing the lagoon helps to overcome this limitation.

The land capability classification is IIe, dryland and irrigated, and the range site is Sandy.

Sh—Shellabarger sandy loam, 1 to 3 percent slopes. This deep, gently sloping, well drained soil is on ridgetops and side slopes in the uplands. Individual areas are irregular in shape and range from 30 to several hundred acres in size.

Typically, the surface soil is brown sandy loam about 11 inches thick. The subsoil is friable sandy clay loam about 27 inches thick. The upper part is reddish brown, and the lower part is reddish yellow. The substratum to a depth of about 60 inches is reddish yellow, calcareous sandy loam. In some areas the subsoil is clay loam. In other areas the depth to calcareous material is less than 36 inches.

Included with this soil in mapping are small areas of Albion soils on knolls. These soils are more sandy than the Shellabarger soil. They make up about 10 percent of the map unit.

Permeability and available water capacity are moderate in the Shellabarger soil. Runoff and natural fertility are medium. The surface layer is friable, and tilth is good.

Most areas are used for cultivated crops. Some are used as range. This soil is well suited to wheat and grain sorghum. Water erosion and soil blowing are hazards if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and soil blowing and conserve moisture.

This soil is well suited to irrigated corn and grain sorghum. Returning crop residue to the soil and adding other organic material improve tilth and fertility and increase the rate of water infiltration. Efficient water management is needed. Land leveling or contour furrowing reduces the runoff rate and improves water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because seepage and slope are limitations. Seepage can be controlled by sealing the lagoon. Some land shaping commonly is needed to overcome the slope.

Figure 12.—An area of Tivoli fine sand, hilly.

The land capability classification is IIe, dryland and irrigated, and the range site is Sandy.

Sm—Shellabarger sandy loam, 3 to 6 percent slopes. This deep, moderately sloping, well drained soil is on side slopes in the uplands. Individual areas are irregular in shape and range from 30 to 100 acres in size.

Typically, the surface soil is brown sandy loam about 11 inches thick. The subsoil is friable sandy clay loam about 27 inches thick. The upper part is reddish brown, and the lower part is reddish yellow. The substratum to a depth of about 60 inches is reddish yellow, calcareous sandy loam. In some areas the subsoil is clay loam. In other areas the depth to calcareous material is less than 36 inches.

Included with this soil in mapping are small areas of Albion soils on knolls. These soils are more sandy than the Shellabarger soil. They make up about 10 percent of the map unit.

Permeability and available water capacity are moderate in the Shellabarger soil. Runoff and natural fertility are medium. The surface layer is friable, and tilth is good.

Most areas are used as range. Some are used for cultivated crops. This soil is moderately well suited to wheat and grain sorghum. Water erosion and soil blowing are hazards if cultivated crops are grown. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and soil blowing and conserve moisture.

This soil is suited to range. No major problems affect the use of this soil as range. Water erosion and soil blowing are hazards, however, if the range is overgrazed. They can be controlled by maintaining an adequate plant cover.

In many areas of this soil, range is adjacent to cropland. These areas can be managed as habitat for upland wildlife, such as pheasants. Planting shrubs in these areas provides winter cover for the wildlife.

This soil is well suited to dwellings and septic tank absorption fields. It is only moderately well suited to sewage lagoons because slope and seepage are limitations. Seepage can be controlled by sealing the lagoon. Some land shaping commonly is needed to overcome the slope.

The land capability classification is IIIe, dryland, and the range site is Sandy.

Tv—Tivoli fine sand, hilly. This deep, excessively drained soil is on uplands (fig. 12). Individual areas are irregular in shape and range from 30 to several hundred acres in size.

Typically, the surface layer is brown fine sand about 6 inches thick. The substratum to a depth of about 60 inches is light yellowish brown fine sand. In some areas it is loamy fine sand.

Permeability is rapid, and runoff is very slow. Available water capacity and natural fertility are low.

Nearly all areas are used as range. Because of a very severe hazard of soil blowing, this soil is generally unsuited to cultivated crops. It is better suited to range. Droughtiness is a concern in managing the soil as range. Also, soil blowing is a hazard if the range is overgrazed. It can be controlled by maintaining an adequate plant cover.

This soil has poor potential for rangeland wildlife habitat. Lesser prairie chickens often inhabit the areas where the range is in good or excellent condition.

This soil is generally unsuited to building site development because of the slope. Seepage and a poor filtering capacity are additional limitations on sites for sanitary facilities.

The land capability classification is VIIe, and the range site is Choppy Sands.

Wd—Waldeck fine sandy loam, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains. Individual areas are irregular in shape and range from 20 to several hundred acres in size.

Typically, the surface soil is grayish brown, calcareous fine sandy loam about 13 inches thick. The next layer is brown, very friable, calcareous fine sandy loam about 13 inches thick. It is mottled in the lower part. The upper part of the substratum is yellowish brown, mottled, calcareous fine sandy loam. The lower part to a depth of about 60 inches is very pale brown, calcareous sand.

Included with this soil in mapping are small areas of Kanza, Lincoln, and Zenda soils. Kanza and Lincoln soils are sandy. The poorly drained Kanza soils are in swales, and the somewhat excessively drained Lincoln soils are on the higher flood plains. Zenda soils are more clayey than the Waldeck soil. They are in positions on the landscape similar to those of the Waldeck soil. Included soils make up about 15 percent of the map unit.

Permeability is moderately rapid in the Waldeck soil, and runoff is slow. Available water capacity is moderate, and natural fertility is medium. The surface layer is very friable, and tilth is good. A seasonal high water table is at a depth of 2 to 4 feet from late fall through early spring.

Most areas are used as range. Some are used for cultivated crops. This soil is moderately well suited to wheat and grain sorghum. The flooding and the seasonal high water table are management concerns, but the crops commonly benefit from the additional moisture. Planting and harvesting are delayed by the wetness in some years. Soil blowing is a hazard during dry periods. Minimizing tillage and leaving crop residue on the surface help to control soil blowing and conserve moisture.

This soil is well suited to range. The seasonal high water table improves the production of native grasses. Pits dug to the water table provide water for livestock (fig. 13). The flooding and the wetness can be problems in the spring.

Some areas of this soil are suitable for the development of wildlife habitat. The areas of grass and trees adjacent to the streams provide excellent habitat for turkey, deer, and quail.

Figure 13.—A pit dug in an area of Waldeck fine sandy loam, occasionally flooded.

This soil is unsuited to building site development because of the flooding and the wetness.

The land capability classification is IIIw, dryland, and the range site is Subirrigated.

We—Westview silt loam, 0 to 1 percent slopes. This deep, nearly level, well drained soil is on broad stream terraces. Individual areas are irregular in shape and range from 40 to several hundred acres in size.

Typically, the surface layer is brown silt loam about 5 inches thick. The subsurface layer is brown silt loam about 10 inches thick. The subsoil is calcareous silty clay loam about 35 inches thick. The upper part is brown and friable, the next part is brown and firm, and the lower part is light reddish brown and firm. The substratum to a depth of about 60 inches is light reddish brown, calcareous silty clay loam.

Permeability is moderately slow, and runoff is slow. Available water capacity and natural fertility are high. The shrink-swell potential is moderate in the subsoil. The surface layer is friable, and tilth is good.

Nearly all areas are used for cultivated crops. Some are irrigated. This soil is well suited to wheat and grain sorghum. Inadequate rainfall is the main management concern. Returning crop residue to the soil and minimizing tillage improve fertility and tilth and conserve moisture.

This soil is well suited to irrigated corn and grain sorghum. Returning crop residue to the soil and adding other organic material improve tilth and fertility and

increase the rate of water infiltration. Efficient water management is needed. Land leveling or contour furrowing reduces the runoff rate and improves water distribution in areas irrigated by a flooding system. Tailwater pits help to recover irrigation water.

This soil is moderately well suited to dwellings, well suited to sewage lagoons, and poorly suited to septic tank absorption fields. The shrink-swell potential is a limitation on sites for dwellings. Properly designing and reinforcing foundations, installing foundation drains, and backfilling with suitable coarse textured material around the foundations help to prevent the structural damage caused by shrinking and swelling. The moderately slow permeability restricts the absorption of effluent in septic tank absorption fields. Increasing the size of the absorption field or installing the lateral lines below the subsoil helps to overcome this limitation.

The land capability classification is IIc, dryland, and I, irrigated. The range site is Loamy Upland.

Wf—Wellsford clay, 6 to 25 percent slopes. This shallow, strongly sloping to steep, well drained soil is on narrow divides and side slopes in the uplands. Individual areas are irregular in shape and range from 50 to several hundred acres in size.

Typically, the surface layer is grayish brown clay about 5 inches thick. The subsoil is olive, very firm, calcareous clay about 12 inches thick. Dark grayish brown, clayey shale bedrock is at a depth of about 17 inches. In some areas the depth to shale is more than 20 inches.

Included with this soil in mapping are small areas of Hedville and Lancaster soils and shale and sandstone outcrops on the steeper side slopes along drainageways. Hedville and Lancaster soils are loamy. Included areas make up about 20 percent of the map unit.

Permeability is very slow in the Wellsford soil, and runoff is rapid. Available water capacity is very low. Natural fertility is low. The shrink-swell potential is high throughout the soil. Root penetration is restricted by the shale bedrock at a depth of about 17 inches.

Nearly all areas are used as range (fig. 14). Because of a severe hazard of water erosion, this soil is generally unsuited to cultivated crops. It is better suited to range. Droughtiness is a concern in managing the soil as range. Because of the slope, water erosion is a hazard unless an adequate plant cover is maintained. Gullies form along some cattle trails. During extended wet periods, the soil tends to shear and slide down the steeper slopes. The sheared areas are bare. Reestablishing vegetation is difficult in the gullied or sheared areas. Fencing and other means of controlling livestock traffic patterns help to prevent gullying and soil slippage.

This soil is generally unsuited to building site development because of the slope and the shrink-swell potential. Seepage is an additional limitation on sites for sanitary facilities.

The land capability classification is VIe, dryland, and the range site is Blue Shale.

Wo—Woodward loam, 1 to 3 percent slopes. This moderately deep, gently sloping, well drained soil is on uplands. Individual areas are irregular in shape and range from 50 to several hundred acres in size.

Typically, the surface layer is reddish brown loam about 7 inches thick. The subsoil is friable, calcareous loam about 23 inches thick. The upper part is reddish brown, and the lower part is red. Weakly cemented, calcareous sandstone bedrock is at a depth of about 30 inches. In some areas the surface layer is fine sandy loam. In a few areas the depth to sandstone is less than 20 inches.

Included with this soil in mapping are small areas of the deep Carey and Clark soils. Carey soils are on the lower parts of the landscape. Clark soils are in positions on the landscape similar to those of the Woodward soil. Included soils make up about 10 percent of the map unit.

Permeability is moderate in the Woodward soil, and runoff is medium. Available water capacity and natural fertility are low. The surface layer is friable, and tilth is good. Root penetration is restricted by the sandstone bedrock at a depth of about 30 inches.

Most areas are used for cultivated crops. A few are used as range. This soil is well suited to wheat and grain sorghum. Water erosion is a hazard if cultivated crops are grown. The low available water capacity also is a management concern. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture.

This soil is well suited to dwellings. It is generally unsuited to septic tank absorption fields and sewage lagoons because of seepage. The deep included soils are better sites for sanitary facilities.

The land capability classification is IIe, dryland, and the range site is Loamy Upland.

Ws—Woodward-Quinlan loams, 3 to 6 percent slopes. These moderately sloping, well drained soils are on uplands. The moderately deep Woodward soil is on side slopes, and the shallow Quinlan soil is on

Figure 14.—An area of Wellsford clay, 6 to 25 percent slopes, used as range.

ridges. Individual areas are irregular in shape and range from 25 to several hundred acres in size. They are about 55 percent Woodward soil and 35 percent Quinlan soil. The two soils occur as areas so intricately mixed or so small that mapping them separately is not practical.

Typically, the Woodward soil has a surface layer of reddish brown loam about 7 inches thick. The subsoil is friable, calcareous loam about 23 inches thick. The upper part is reddish brown, and the lower part is red. Weakly cemented, calcareous sandstone bedrock is at a depth of about 30 inches. In some areas the surface layer is fine sandy loam.

Typically, the Quinlan soil has a surface layer of yellowish red, calcareous loam about 7 inches thick. The subsoil is red, friable, calcareous loam about 7 inches thick. Weakly cemented, calcareous sandstone bedrock is at a depth of about 14 inches.

Included with these soils in mapping are small areas of the deep Carey and Clark soils. These included soils are generally in the less sloping areas. They make up about 10 percent of the map unit.

Permeability is moderate in the Woodward and Quinlan soils, and runoff is medium. Available water capacity is low in the Woodward soil and very low in the Quinlan soil. Natural fertility is low in both soils. Root penetration is restricted by the sandstone bedrock at a depth of about 30 inches in the Woodward soil and 14 inches in the Quinlan soil.

Most of the acreage is used for cultivated crops. The rest is used as range. These soils are poorly suited to wheat and grain sorghum. Water erosion is a hazard if cultivated crops are grown. Droughtiness and the low fertility also are management concerns. Terracing, farming on the contour, minimizing tillage, and leaving crop residue on the surface help to control water erosion and conserve moisture.

These soils are suited to range. Droughtiness is a

concern in managing these soils as range. Because of the slope, water erosion is a hazard unless an adequate plant cover is maintained.

These soils are well suited to dwellings. They are generally unsuited to septic tank absorption fields and sewage lagoons because of seepage. The deep included soils in the less sloping areas are better sites for sanitary facilities.

The land capability classification is IVe, dryland. The Woodward soil is in the Loamy Upland range site, and the Quinlan soil is in the Shallow Prairie range site.

Ye—Yahola fine sandy loam, occasionally flooded. This deep, nearly level, well drained soil is on flood plains. Individual areas are irregular in shape and range from 10 to 50 acres in size.

Typically, the surface soil is brown, calcareous fine sandy loam about 12 inches thick. The upper part of the substratum is brown, calcareous fine sandy loam. The lower part to a depth of about 60 inches is pink, calcareous loamy fine sand.

Included with this soil in mapping are small areas of the somewhat excessively drained, sandy Lincoln soils. These soils are in positions on the flood plains similar to those of the Yahola soil. They make up about 10 percent of the map unit.

Permeability is moderately rapid in the Yahola soil, and runoff is slow. Available water capacity is moderate, and natural fertility is low. The surface layer is very friable, and tilth is good.

Most areas are used as range. Some small areas are used for cultivated crops. This soil is well suited to wheat and grain sorghum. The flooding is a hazard, but the crops commonly benefit from the additional moisture. Soil blowing is a hazard during dry periods. Minimizing tillage and leaving crop residue on the surface conserve moisture and help to control soil blowing.

This soil is well suited to range. Soil blowing is a hazard if the range is overgrazed. It can be controlled by maintaining an adequate plant cover.

Some areas of this soil are suitable for the development of wildlife habitat. The areas of grass and trees adjacent to the streams provide excellent habitat for turkey, deer, and quail.

This soil is unsuited to building site development because of the flooding.

The land capability classification is IIw, dryland, and the range site is Sandy Lowland.

Ze—Zenda clay loam, occasionally flooded. This deep, nearly level, somewhat poorly drained soil is on flood plains. Individual areas are irregular in shape and range from 20 to 160 acres in size.

Typically, the surface layer is brown, calcareous clay loam about 6 inches thick. The subsurface layer is grayish brown, calcareous clay loam about 6 inches thick. The substratum to a depth of about 60 inches is calcareous clay loam. The upper part is brown, and the lower part is light gray and mottled. In some areas the soil has a subsoil of fine sandy loam.

Permeability is moderate, and runoff is slow. Available water capacity is high, and natural fertility is medium. The surface layer is friable, and tilth is good. A seasonal high water table is at a depth of 2 to 4 feet from late fall through early spring. The shrink-swell potential is moderate throughout the soil.

Most areas are used for cultivated crops. The rest are used as range. This soil is well suited to wheat and grain sorghum. The flooding and the seasonal high water table are management concerns, but the crops commonly benefit from the additional moisture. Measures that conserve moisture are needed during dry periods. Minimizing tillage and leaving crop residue on the surface help to maintain tilth and fertility and increase the rate of water infiltration.

This soil is suited to range. The seasonal high water table improves the production of native grasses. The flooding and the wetness can be problems in the spring. Compaction also can become a problem, but it can be controlled by restricted grazing during wet periods.

Some areas of this soil are suitable for the development of wildlife habitat. The areas of grass and trees adjacent to the streams provide excellent habitat for turkey, deer, and quail.

This soil is unsuited to building site development because of the flooding and the wetness.

The land capability classification is IIw, dryland, and the range site is Subirrigated.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food,

feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban and built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal inputs of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

About 219,250 acres in the survey area, or slightly more than 43 percent of the total acreage, meets the soil requirements for prime farmland. Scattered areas of this land are throughout the county, but most are in the central and western parts, mainly in associations 1, 3, and 7, which are described under the heading "General Soil Map Units." The crops grown on this land, mainly wheat and grain sorghum, account for an estimated one-half of the county's total agricultural income each year.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

The Albion soil listed in table 5 qualifies for prime farmland only in areas where inadequate rainfall has been overcome by irrigation. Onsite evaluation is needed to determine whether or not this limitation has been overcome.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

The soils in the survey area are assigned to a capability classification and a range site at the end of each map unit description and in tables 6 and 7. The capability classification and range site for each map unit also are shown in the section "Interpretive Groups," which follows the tables at the back of this survey.

Crops

Jerry B. Lee, conservation agronomist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 168,400 acres in Comanche County, or 33 percent of the total acreage, is used for cultivated crops or is summer fallowed. During the period 1974 to 1984, wheat was grown on about 55 percent of the cropland, grain sorghum and forage sorghum on 10 percent, and alfalfa, corn, oats, soybeans, or sunflowers on 10 percent *(4)*. About 25 percent of the cropland was summer fallowed. The acreage used for corn and for alfalfa and other kinds of hay increased during this period compared to that of the previous 10-year period. The acreage used for soybeans, although still representing only a small percentage of the cropland, has been increasing dramatically.

About 7 percent of the cropland is irrigated. Grain sorghum, corn, wheat, soybeans, and alfalfa are the principal irrigated crops. Wheat is double-cropped with soybeans and grain sorghum.

Crop production can be increased on most farms by applying the latest technology. This soil survey can facilitate the application of such technology. The main concerns in managing the soils in Comanche County for cultivated crops are controlling water erosion and soil

blowing, making the most efficient use of the available water, and maintaining fertility and tilth.

Water erosion is the major hazard on about 50 percent of the cropland. It occurs mainly in areas where the slope is more than 1 or 2 percent. Examples are the more sloping areas of Abilene, Albion, Carey, Case, Clark, Farnum, Holdrege, Kingsdown, Ost, St. Paul, Shellabarger, and Woodward soils. Unless the surface is protected by a crop or crop residue, soil blowing is a hazard on some of the soils that have a surface layer of sandy loam, fine sandy loam, or loamy fine sand. Examples are Albion, Canadian, Kingsdown, Pratt, and Shellabarger soils.

Loss of the surface layer through erosion is damaging for two reasons. First, productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Secondly, erosion results in the pollution of streams by sediments, nutrients, and pesticides. Control of erosion minimizes this pollution and improves the quality of water.

Erosion-control measures provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods helps to control erosion and preserves the productive capacity of the soils.

Conservation tillage and conservation cropping systems help to control water erosion and soil blowing. A system of conservation tillage leaves all or part of the crop residue on the surface. Examples are stubble mulching and chemical fallow. When these systems are applied, the stubble of crops or crop residue is left essentially in place to provide a protective cover before and during the preparation of a seedbed and at least a partial cover for the succeeding crop. Drilled crops, such as small grain, are alternated with row crops in a conservation cropping system. Wind stripcropping, or the production of crops in relatively narrow strips perpendicular to the direction of the prevailing wind, also is used in conservation cropping systems to help control soil blowing.

Terraces, diversions, grassed waterways, and contour farming are needed in combination with conservation tillage on soils that have a slope of more than 2 percent. If a system of conservation tillage is not applied, they are also needed on soils that have a slope of more than 1 percent. Terraces and diversions help to control erosion by shortening the length of slopes and reducing the runoff rate. They are most practical on deep, well drained soils that have uniform slopes. Contour farming should generally be used in combination with terraces. It is best suited to soils that have smooth, uniform slopes and are suitable for terracing.

Measures that control water erosion and soil blowing on soils used for dryland crops can also be applied to irrigated soils. These measures include terraces, contour farming, and conservation tillage. The irrigation system should be one that does not waste the water or result in excessive erosion. Gravity irrigation is the most efficient system if the correct stream size is established for each row and a tailwater recovery system is used to conserve the water. Sprinkler irrigation is the most efficient system on loamy and sandy soils and in undulating areas. Center-pivot sprinklers are effective in applying small amounts of water at frequent intervals.

Inadequate rainfall generally is a problem on all of the cropland in the county. As a result, the supply of water stored in the soil should be conserved or increased by summer fallowing and by terracing. Summer fallowing allows the soil to store moisture during the summer for the growth of succeeding crops. Most of the fallowed cropland in the county is in a wheat-sorghum-fallow or wheat-fallow-wheat rotation. Summer fallowing is most effective when the crop residue is managed by stubble mulching or by chemical fallow. Stubble mulch traps snow and thus increases the moisture supply. Both stubble mulching and terracing reduce the runoff rate.

Organic matter is a storehouse of available plant nutrients. It increases the rate of water intake, helps to prevent surface crusting, helps to control erosion, and improves tilth. Most of the soils in the county that are used for crops have a surface layer of silt loam, sandy loam, loam, or clay loam. A surface crust forms during periods of heavy rainfall. When dry, the crusted surface is nearly impervious to water. As a result, the runoff rate is increased. Regularly adding organic material and leaving crop residue on the surface help to prevent excessive crusting, increase the rate of water infiltration, and reduce the runoff rate and the hazard of erosion.

Plants on most of the arable soils in the county respond well to applications of nitrate and phosphate fertilizer. On all soils, the amount of fertilizer to be applied should be based on the results of soil tests, on the needs of the crop, on the expected level of yields, and on the experience of farmers. The Cooperative Extension Service can help to determine the kind and amount of fertilizer needed.

Information about the design of erosion-control practices is available in the local office of the Soil Conservation Service. The latest information about growing crops can be obtained from the Cooperative

Extension Service or the Soil Conservation Service.

Yields Per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good-quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations or hazards that restrict their use.

Class II soils have moderate limitations or hazards that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations or hazards that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations or hazards that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations or hazards that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations or hazards that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations or hazards that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main hazard is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have

other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Detailed Soil Map Units," in the yields table, and in the section "Interpretive Groups."

Rangeland

H. Lynn Gibson and Glen P. Snell, range conservationists, Soil Conservation Service, helped prepare this section.

About 325,000 acres in Comanche County, or 64 percent of the total acreage, is range. A great diversity of plant species makes up the native grassland in the county. Sand bluestem, little bluestem, switchgrass, and sand sagebrush grow primarily in the drainage basin of the Cimarron River and in a 40-section area directly east of Coldwater, and mid grasses interspersed with eastern redcedar grow in the eastern quarter of the county. Big bluestem, little bluestem, sideoats grama, and blue grama are the dominant species in the rest of the county. The grassland throughout the county is used primarily for grazing.

Cow-calf enterprises and yearling enterprises are about equal in extent (fig. 15). Native grasses provide most of the forage, but they are supplemented by milo stubble, wheat pasture, and other cropland forage. In winter they commonly are supplemented by hay and protein concentrates.

The potential native vegetation is strongly affected by the soils in the county. The texture of the surface layer and of the substratum affects the kind of vegetation. A high content of lime at the surface, salinity, and a seasonal high water table within a depth of 5 feet affect the kind and amount of forage species.

Range Sites and Condition Classes

Soils vary in their capacity to produce grasses and other forage plants. The plant community in an area that is characterized by at least 75 percent climax vegetation is relatively stable and is indicative of what the soil in the area is capable of producing. Climax vegetation reproduces itself and changes in composition very little as long as the environment remains unchanged. The climax vegetation consists of the plants that grew on the prairie when the region was first settled. It generally is the most productive combination of forage plants on a range site.

Range plants respond to grazing pressure as decreasers, increasers, or invaders. Decreasers are plants in the climax vegetation that tend to decrease in a relative amount under close, continuous grazing. They generally are the tallest and most productive perennial grasses and forbs and are the most palatable to livestock.

Increasers are plants in the climax vegetation that increase in relative amount as the extent of the more desirable plants is reduced by close grazing. They generally are shorter than decreasers and are less palatable to livestock.

Invaders are plants that cannot compete with the climax plant community for moisture, nutrients, and light. They invade the site and grow along with increasers after the extent of the climax vegetation has been reduced by continuous heavy grazing. Invaders generally have little value for grazing.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 7 shows, for each soil, the range site and the potential annual production of vegetation in favorable, average, and unfavorable years. An explanation of the column headings in table 7 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was ascertained during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

Potential annual production is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, average, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

Yields are adjusted to a common percent of air-dry moisture content. The relationship of green weight to

Figure 15.—Yearling steers in an area of Clairemont silt loam, occasionally flooded. Obaro-Rock outcrop complex, 10 to 30 percent slopes, is in the background.

air-dry weight varies according to such factors as exposure, amount of shade, recent rains, and unseasonable dry periods.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only.

Range condition is judged according to standards that apply to a particular range site. Four range condition classes are used to indicate the present condition of the native vegetation on a range site in relation to the climax vegetation for that site. A range is in excellent condition if 76 to 100 percent of the vegetation is of the same kind as that in the climax stand; in good condition if the percentage is 51 to 75; in fair condition if the percentage is 26 to 50; and in poor condition if the percentage is 25 or less.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, control of undesirable brush species, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat

below the potential meets grazing needs, provides wildlife habitat, and protects soil and water resources.

Good range management keeps the range in excellent or good condition. The main management concern is recognizing the changes in the plant cover that take place gradually and can be misinterpreted or overlooked. Growth resulting from heavy rainfall may lead to the conclusion that the range is in good condition when actually the cover is weedy and the long-term trend is toward lower production. On the other hand, some areas that have been closely grazed for a short period may have a degraded appearance that temporarily obscures the quality of the range and its ability to recover.

After years of prolonged overgrazing, seed sources of desirable vegetation may have been eliminated. Brush control, range seeding, fencing, and the development of watering facilities revitalize the stands of native plants. Thereafter, deferred grazing, proper grazing use, and a planned grazing system help to maintain or improve the range.

The soils in the survey area are assigned to the Blue Shale, Choppy Sands, Limy Upland, Loamy Lowland, Loamy Terrace, Loamy Upland, Saline Lowland, Saline Subirrigated, Sands, Sandy, Sandy Lowland, Sandy Terrace, Shallow Prairie, Shallow Sandstone, and Subirrigated range sites. These sites are described in the paragraphs that follow.

Blue Shale range site. The soils in this range site are on uplands. The potential native vegetation is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 35 percent of the vegetation; little bluestem, 20 percent; sideoats grama, 15 percent; and indiangrass, 5 percent. Other grasses are blue grama, buffalograss, switchgrass, tall dropseed, and western wheatgrass. Forbs, such as dotted gayfeather, Illinois bundleflower, slimflower scurfpea, and upright prairie coneflower, make up about 5 percent. Leadplant, pricklypear, and small soapweed also make up about 5 percent.

Initial overgrazing on this site generally reduces the extent of big bluestem. Under these conditions, little bluestem becomes the dominant species. After periods of continued overgrazing, western wheatgrass, blue grama, and buffalograss become the dominant species. Once this site is denuded by overgrazing or soil slippage, restoring productivity is difficult. Reseeding is difficult because of the slope and a high content of clay in the soils.

This site can generally be maintained near its original potential or can be improved from a deteriorated condition by proper stocking rates and a planned grazing system. Less intensive grazing on the steeper slopes than in the more nearly level areas, which can be slightly overgrazed, commonly improves the site.

Choppy Sands range site. The soils in this range site are on uplands. The potential native vegetation is tall prairie grasses. Typically, the dominant grasses are sand bluestem, which makes up about 35 percent of the vegetation; little bluestem, 10 percent; indiangrass, 10 percent; switchgrass, 10 percent; and big sandreed, 10 percent. Other grasses are sand dropseed, sand paspalum, Texas bluegrass, blue grama, hairy grama, and sideoats grama. Forbs, such as lemon scurfpea, prairie sagewort, tenpetal blazingstar, western ragweed, and Virginia tephrosia, make up as much as 10 percent. Chickasaw plum, pricklypear, sand sagebrush, and small soapweed make up about 5 percent.

Overgrazing on this site results in a decrease in the extent of sand bluestem, switchgrass, little bluestem, and big sandreed and an increase in the extent of sand dropseed, sand paspalum, blue grama, hairy grama, and sand sagebrush. If overuse continues, all of the tall grasses and most of the mid grasses are removed. Because of the susceptibility of the sandy surface layer to soil blowing, active dunes and blowouts generally form when the site deteriorates.

Because of a limited available water capacity in the soils and poor management in the past, many areas of this range site are in poor condition. Maintaining the extent of the preferred grasses is difficult. A planned grazing system that includes proper stocking rates and periodic deferment of grazing during the growing season helps to maintain a permanent cover of vegetation. It also improves the vigor of some of the desirable species. Deferring grazing for the entire grazing season or longer is not so effective in stabilizing the site as alternating grazing and rest periods within the grazing season.

Limy Upland range site. The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 35 percent of the vegetation; little bluestem, 15 percent; sideoats grama, 15 percent; and blue grama, 10 percent. Other grasses are indiangrass, switchgrass, tall dropseed, western wheatgrass, buffalograss, and sand dropseed. Forbs, such as blacksamson, catclaw sensitivebrier, dotted gayfeather, heath aster, purple prairie-clover, slimflower scurfpea,

and western ragweed, make up about 10 percent. The site supports a small amount of leadplant, pricklypear, and small soapweed.

Big bluestem rapidly loses its productive capacity during periods of continuous overgrazing on this site. As the extent of big bluestem is reduced, the extent of little bluestem and sideoats grama initially increases. It decreases, however, during periods of continuous heavy grazing. The extent of blue grama and buffalograss increases as the extent of the taller grasses decreases. Continued excessive overuse results in a pasture of short grasses. If overuse continues, erosion results in the formation of gullies and catsteps on the steeper parts of the site.

In the steeper, less accessible areas, the preferred grasses generally are not excessively grazed. These areas are sources of seed for the better forage plants after long periods of drought, overgrazing, or both. Poor grazing distribution is a problem because the livestock prefer the more gently sloping areas. Measures that distribute the grazing evenly, proper stocking rates, and a scheduled deferment of grazing during the growing season help to restore this site to its original potential. Properly located salting and watering facilities help to achieve an even distribution of grazing. Other management measures, such as concentrated grazing and a planned grazing system, also are beneficial.

Loamy Lowland range site. The soils in this range site are on flood plains and are frequently flooded or occasionally flooded. The potential native vegetation is tall prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 40 percent of the vegetation; eastern gamagrass, 10 percent; indiangrass, 10 percent; and switchgrass, 10 percent. Other grasses are little bluestem, blue grama, prairie cordgrass, sideoats grama, tall dropseed, western wheatgrass, Canada wildrye, and red threeawn. Forbs, such as American licorice, catclaw sensitivebrier, Illinois bundleflower, Maximilian sunflower, pitcher sage, Baldwin ironweed, heath aster, Louisiana sagewort, and western ragweed, make up about 10 percent. American plum, Jersey tea, green ash, hackberry, indigobush, leadplant, and cottonwood make up about 5 percent.

Because it receives extra moisture and supports the deeper rooted plants, this site is a preferred grazing area, especially during periods of moisture stress. Overgrazing reduces the extent of big bluestem, eastern gamagrass, indiangrass, switchgrass, and Canada wildrye and of palatable forbs, such as American licorice, catclaw sensitivebrier, Illinois bundleflower, and Maximilian sunflower. Western wheatgrass, blue grama, red threeawn, tall dropseed, Baldwin ironweed, western ragweed, and scarlet globemallow are the principal increasers.

In areas where overgrazing has continued for a few years, the site can often be returned to near its original potential by management that includes proper grazing use and a scheduled deferment of grazing during the growing season. If the site has been overgrazed for a long period, recovery may be slow even when good management is applied. Under these conditions, western wheatgrass generally becomes the dominant grass and the site has significant amounts of blue grama, tall dropseed, red threeawn, buffalograss, and sideoats grama.

Loamy Terrace range site. The soils in this range site are on nearly level stream terraces and are subject to flooding. The potential native vegetation is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 40 percent of the vegetation; sideoats grama, 15 percent; little bluestem, 10 percent; and western wheatgrass, 10 percent. Other grasses are Canada wildrye, indiangrass, switchgrass, blue grama, buffalograss, sand dropseed, and tall dropseed. Forbs, such as American licorice, aromatic aster, catclaw sensitivebrier, heath aster, Illinois bundleflower, Louisiana sagewort, pitcher sage, slimflower scurfpea, and western ragweed, make up about 5 percent. Small amounts of American plum, pricklypear, and small soapweed are common.

This site is generally grazed along with larger areas of upland range sites. Because of the combination of sites, carefully applied management measures, such as fencing and the proper location of water, salt, minerals, and feeding areas, are needed to achieve an adequate distribution of grazing. After periods of continued excessive use, the extent of big bluestem, little bluestem, and sideoats grama decreases. Long-term overgrazing may remove these species from the site. Western wheatgrass is the major increaser, along with forbs, blue grama, and buffalograss. Returning a continuously overgrazed area to its original productive potential is difficult. In areas that have remnant stands of the taller grasses, proper stocking rates and periodic deferment of grazing or a planned grazing system help to return the site to near its original potential.

Loamy Upland range site. The potential native vegetation on this site is mixed prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 20 percent of the vegetation; sideoats grama, 15 percent; western wheatgrass, 15 percent;

and blue grama, 10 percent. Other grasses are indiangrass, little bluestem, buffalograss, sand dropseed, switchgrass, tall dropseed, Canada wildrye, red threeawn, and Scribner panicum. Forbs, such as western ragweed, Louisiana sagewort, slimflower scurfpea, dotted gayfeather, daisy fleabane, heath aster, and scarlet globemallow, make up about 15 percent. A small amount of leadplant is common.

Initial overgrazing on this site generally reduces the extent of big bluestem and little bluestem. Under these conditions, sideoats grama and blue grama become the dominant vegetation. After periods of continued overgrazing, blue grama, buffalograss, and lesser amounts of western wheatgrass become the dominant species. Under these conditions, the proportion of blue grama to buffalograss is determined by grazing pressure and weather cycles. After a combination of continued heavy grazing and a long dry cycle, buffalograss tends to become the dominant species. If grazing is moderate, blue grama generally becomes the dominant species. Only destructive grazing removes buffalograss and blue grama from the site.

Once most of the taller species are removed from this site through grazing pressure and dry weather cycles, restoring the potential native vegetation is extremely difficult and may take several decades. In areas that have remnant stands of the taller species, the site can be returned to its original potential by proper stocking rates and a system of grazing that includes a scheduled deferment of grazing during the growing season. Maintaining significant amounts of big bluestem and little bluestem is difficult without a grazing system that includes rest periods.

Saline Lowland range site. The soils in this range site are on stream terraces that are rarely flooded. The potential native vegetation is mixed prairie grasses that are salt tolerant. Typically, the dominant grasses are alkali sacaton, which makes up about 35 percent of the vegetation; switchgrass, 15 percent; inland saltgrass, 15 percent; tall dropseed, 10 percent; and alkali cordgrass, 5 percent. Other grasses are western wheatgrass, blue grama, buffalograss, sand dropseed, Scribner panicum, and perennial threeawns. Forbs, such as heath aster, purple prairie-clover, and western ragweed, make up about 10 percent.

Overgrazing on this site causes a rapid increase in the extent of inland saltgrass and western wheatgrass and a decrease in the extent of most other grasses, except for alkali sacaton. Excessive use can almost create a monoculture of inland saltgrass.

This site can generally be maintained near its original potential or can be improved from a deteriorated condition by proper stocking rates and a planned grazing system. Recovery generally is slower on this site than on nonsaline sites. Grazing early in the growing season is important because the salt-tolerant species tend to mature rapidly and become much less palatable late in the season. Periodic deferment of grazing helps to maintain the productivity and vigor of the preferred grasses. Controlled burning may be beneficial, especially where the site supports alkali cordgrass and inland saltgrass.

Saline Subirrigated range site. The soils in this range site are on bottom land that is occasionally flooded. They are generally wet throughout the spring and early summer. The potential native vegetation is mixed prairie grasses that are mainly salt tolerant. Typically, the dominant grasses are alkali sacaton, which makes up about 25 percent of the vegetation; switchgrass, 20 percent; alkali cordgrass, 10 percent; inland saltgrass, 10 percent; and tall dropseed, 10 percent. Other grasses are western wheatgrass, blue grama, buffalograss, sand dropseed, Scribner panicum, indiangrass, and red threeawn. Forbs, such as heath aster, Pennsylvania smartweed, purple prairie-clover, and western ragweed, make up about 10 percent. The site supports a small amount of willow baccharis.

Unless it lasts for a long period, overgrazing on this site has little effect on species composition, but it can easily reduce the small amounts of indiangrass and switchgrass. Tamarisk is a common invader. Excessive use can reduce the productivity of the site by reducing the vigor of the grasses and by increasing the extent of inland saltgrass at the expense of the taller species.

Proper stocking rates and timely grazing help to maintain the productivity of this site. Grazing early in the growing season is important because the species tolerant of saline-alkali conditions tend to mature rapidly and become much less palatable late in the season. Periodic deferment of grazing helps to maintain the productivity and vigor of the dominant grasses.

Sands range site. The soils in this range site are on uplands. The potential native vegetation is tall prairie grasses. Typically, the dominant grasses are sand bluestem, which makes up about 30 percent of the vegetation; little bluestem, 15 percent; big sandreed, 10 percent; and sand lovegrass, 10 percent. Other grasses are indiangrass, sideoats grama, switchgrass, blue grama, sand dropseed, sand paspalum, Scribner panicum, and western wheatgrass. Forbs, such as Engelmann daisy, lemon scurfpea, Louisiana sagewort,

prairie sunflower, silktop dalea, silky prairie-clover, tenpetal blazingstar, and western ragweed, make up about 10 percent. Chickasaw plum, sand sagebrush, pricklypear, and small soapweed make up about 10 percent.

The soils in this site have a surface layer of loamy fine sand. They take in water rapidly and release it readily to plants. As a result, the taller species can grow in areas of restricted rainfall. During extended dry periods, the extent of sideoats grama, little bluestem, blue grama, and sand dropseed increases at the expense of sand bluestem.

Overgrazing on this site rapidly reduces the extent of sand bluestem. After periods of continued overgrazing, the extent of sideoats grama, little bluestem, sand lovegrass, switchgrass, and Engelmann daisy is reduced. In some areas the vegetation has deteriorated to a stand of sand dropseed, sand sagebrush, small soapweed, pricklypear, and lesser amounts of unpalatable forbs and grasses.

Management that includes proper grazing use and a scheduled deferment of grazing during the growing season is effective in maintaining the productivity of this site. If climatic conditions are favorable, these measures can rapidly restore the site to its original potential in areas that have sufficient remnants of the original plant community.

Sandy range site. The soils in this range site are on uplands. The potential native vegetation is mixed prairie grasses. Typically, the dominant grasses are little bluestem, which makes up about 20 percent of the vegetation; sand bluestem and big bluestem, 15 percent; switchgrass, 10 percent; sideoats grama, 10 percent; and blue grama, 10 percent. Other grasses are sand lovegrass, buffalograss, sand dropseed, western wheatgrass, big sandreed, sand paspalum, and Scribner panicum. Forbs, such as Louisiana sagewort, poppymallow, slimflower scurfpea, upright prairie coneflower, western ragweed, and yarrow, make up about 10 percent. Chickasaw plum, sand sagebrush, and small soapweed make up about 5 percent.

This site generally is a highly preferred grazing area. Because of past grazing management, it is generally in poorer condition than most of the adjacent sites. Overgrazing rapidly reduces the extent of big bluestem and sand bluestem, which are generally replaced by sideoats grama, blue grama, and sand dropseed. If overgrazing continues, the extent of little bluestem, switchgrass, and sand lovegrass is reduced. After long periods of severe overgrazing, the site is dominated by sand dropseed, sand paspalum, annual grasses, unpalatable forbs, and woody species.

Management that includes proper grazing use and a scheduled deferment of grazing during the growing season helps to maintain the productivity of this site. Also, it can restore overgrazed areas to their original potential if remnants of the original species are included in the plant community. Reseeding may be needed in areas where the more desirable mid and tall grasses have been removed.

Sandy Lowland range site. The soils in this range site are on flood plains adjacent to stream channels and are occasionally flooded. The potential native vegetation is tall prairie grasses. Typically, the dominant grasses are sand bluestem, which makes up about 30 percent of the vegetation; little bluestem, 15 percent; indiangrass, 10 percent; and switchgrass, 10 percent. Other grasses are big sandreed, Canada wildrye, sand lovegrass, sideoats grama, western wheatgrass, blue grama, sand dropseed, perennial threeawns, and tall dropseed. Forbs, such as catclaw sensitivebrier, Engelmann daisy, heath aster, Illinois bundleflower, Maximilian sunflower, Louisiana sagewort, and western ragweed, make up about 10 percent. Chickasaw plum, cottonwood, sandbar willow, sand sagebrush, and small soapweed make up about 5 percent.

Initial overgrazing on this site reduces the extent of the bluestems. It increases the extent of western wheatgrass and slightly increases the extent of perennial threeawns and the dropseeds. If overgrazing continues, kochia, Russian thistle, and other undesirable annuals invade the site.

This site generally occurs as long, narrow areas rather than extensive areas. As a result, separately managing the site is difficult. Once most of the taller species are removed through grazing pressure and dry weather cycles, restoring the potential native vegetation is difficult. In areas that have remnants of the taller species, management that includes proper stocking rates and a scheduled deferment of grazing during the growing season is effective in restoring the site to near its original potential.

Sandy Terrace range site. The soils in this range site are on stream terraces and are subject to rare flooding. The potential native vegetation is tall prairie grasses. Typically, the dominant grasses are sand bluestem and big bluestem, which make up about 25 percent of the vegetation; switchgrass, 15 percent; indiangrass, 15 percent; and little bluestem, 10 percent. Other grasses are big sandreed, Canada wildrye, sand lovegrass, sideoats grama, western wheatgrass, blue

grama, sand dropseed, perennial threeawns, and tall dropseed. Forbs, such as catclaw sensitivebrier, Engelmann daisy, heath aster, Illinois bundleflower, Maximilian sunflower, Louisiana sagewort, and western ragweed, make up about 10 percent. Chickasaw plum, cottonwood, sand sagebrush, and small soapweed make up about 5 percent.

Initial overgrazing on this site reduces the extent of the bluestems. It increases the extent of western wheatgrass and the dropseeds and slightly increases the extent of perennial threeawns, sand sagebrush, and yucca. After western wheatgrass and the dropseeds become the dominant species, continued overgrazing results in the invasion of kochia, Russian thistle, and other undesirable annuals.

Once most of the taller species are removed from the site through grazing pressure and dry weather cycles, restoring the potential native vegetation is difficult. In areas that have remnants of the taller species, management that includes proper stocking rates and a scheduled deferment of grazing during the growing season helps to restore the site to near its original potential.

Shallow Prairie range site. The soils in this range site are on uplands. The potential native vegetation is mixed prairie grasses. Typically, the dominant grasses are little bluestem, which makes up about 30 percent of the vegetation; big bluestem and sand bluestem, 15 percent; sideoats grama, 10 percent; and indiangrass, 5 percent. Other grasses are blue grama, buffalograss, hairy grama, sand dropseed, perennial threeawns, and switchgrass. Forbs, such as dotted gayfeather, white prairie-clover, purple prairie-clover, slimflower scurfpea, Louisiana sagewort, and western ragweed, make up about 10 percent.

Initial overgrazing on this site rapidly reduces the extent of big bluestem and sand bluestem. Under these conditions, little bluestem and sideoats grama become the dominant vegetation. After periods of continued overgrazing, blue grama and buffalograss become the dominant species.

The more gently sloping areas are preferred by livestock. As a result, poor grazing distribution can be a problem. Properly located watering and salting facilities and fences help to distribute the grazing throughout most of the site. The steeper, less accessible areas generally are grazed less intensively. They are sources of seed for the better forage plants after long periods of drought, overgrazing, or both. A planned grazing system that includes proper stocking rates and periodic deferment of grazing during the growing season helps to maintain the site near its original potential.

Shallow Sandstone range site. The soils in this range site are on uplands. The potential native vegetation is mixed prairie grasses. Typically, the dominant grasses are little bluestem, which makes up about 35 percent of the vegetation; big bluestem, 25 percent; sideoats grama, 10 percent; indiangrass, 5 percent; and switchgrass, 5 percent. Other grasses are blue grama, buffalograss, sand dropseed, tall dropseed, and perennial threeawns. Forbs, such as dotted gayfeather, white prairie-clover, purple prairie-clover, slimflower scurfpea, Louisiana sagewort, and western ragweed, make up about 10 percent.

Initial overgrazing on this site generally reduces the extent of big bluestem. Under these conditions, little bluestem and sideoats grama become the dominant vegetation. After periods of continued overgrazing, blue grama, buffalograss, hairy grama, and sand dropseed become the dominant species. Grazing pressure is rarely heavy enough to remove the preferred grasses from the site. Grazing management that includes proper stocking rates and periodic deferment of grazing during the growing season helps to maintain or restore the original native vegetation.

Subirrigated range site. The soils in this range site are on flood plains and are frequently flooded or occasionally flooded. They are generally wet throughout the spring and early summer. The potential native vegetation is tall prairie grasses. Typically, the dominant grasses are big bluestem, which makes up about 25 percent of the vegetation; eastern gamagrass, 20 percent; switchgrass, 10 percent; indiangrass, 5 percent; and prairie cordgrass, 5 percent. Numerous other grasses and grasslike plants make up about 15 percent. Forbs, such as American licorice, Illinois bundleflower, Maximilian sunflower, wholeleaf rosinweed, and tall goldenrod, make up about 15 percent. Almondleaf willow, black willow, buttonbush, cottonwood, indigobush, and willow baccharis make up about 5 percent.

Because of the availability of water, the vegetation on this site remains lush and green throughout the growing season. It attracts grazing animals. As a result, special grazing management is needed to prevent overgrazing.

Initial overgrazing reduces the extent of big bluestem, eastern gamagrass, indiangrass, switchgrass, and prairie cordgrass and of palatable forbs, including Maximilian sunflower, wholeleaf rosinweed, Illinois bundleflower, and sessile tickclover. As the extent of these species is reduced, the extent of western

wheatgrass, meadow dropseed, alkali sacaton, American bulrush, tall goldenrod, and woody plants increases. After periods of continued overgrazing, sideoats grama, blue grama, inland saltgrass, buffalograss, western ragweed, and heath aster become the dominant species.

Unless the plant community is altered by fire or grazing, the vegetation on this site gradually deteriorates into a heavy stand of woody plants, including cottonwood, willow, elm, dogwood, and locust. Under these conditions, the understory occurs as a small amount of Virginia wildrye, green muhly, Texas bluegrass, Kentucky bluegrass, and Scribner panicum. Controlled burning helps to remove the woody species and the excess vegetation in lightly used areas. Grazing management that includes proper stocking rates and periodic deferment of grazing during the growing season helps to maintain the site near its original potential.

Native Woodland, Windbreaks, and Environmental Plantings

Keith A. Ticknor, forester, Soil Conservation Service, helped prepare this section.

In Comanche County wooded areas other than those that support windbreaks are limited to narrow bands along the major streams, to clumps of trees in wet drainageways, and to scattered trees or clumps of trees on shallow soils in the Quinlan-Woodward-Carey soil association, which is described under the heading "General Soil Map Units."

The Lincoln-Waldeck association has the greatest concentration of woodland in the county. Eastern cottonwood, black willow, peachleaf willow, and sandbar willow are the dominant species. Other species include green ash, American elm, hackberry, mulberry, boxelder, Siberian elm, American plum, Chickasaw plum, black walnut, northern catalpa, tamarisk, golden currant, smooth sumac, roughleaf dogwood, indigobush, eastern redbud, willow baccharis, eastern redcedar, Osageorange, elderberry, woolly buckthorn, buttonbush, and vines, such as grape, Virginia creeper, common moonseed, and greenbrier.

Most of the range in the county supports an abundance of Chickasaw plum and fragrant sumac. Also, it has numerous pure stands of black locust, eastern cottonwood, or northern catalpa, which were planted as a result of the Timber Claim Act of 1873 (fig. 16). Tamarisk is especially abundant on the bottom land along the Cimarron River and the Salt Fork of the Arkansas River. Harvestable black walnut has grown along Mule Creek. Eastern redcedar is plentiful in the areas in the northeastern part of the county where the soils are shallow over sandstone. Hackberry, American elm, eastern cottonwood, green ash, black walnut, plum, and sumac grow in the channels of drainageways in this part of the county.

The gallery forest in the county owes its existence to the availability of ground water along streams. It is less productive than the climax vegetation of a deciduous forest because of the semiarid environment and a scarcity of seed sources.

Commercial use of the small amount of woodland is very limited. The trees on the bottom land along streams can be used for wood products, such as sawtimber and firewood. This land is used for other purposes, however, and is unlikely to be converted to woodland.

Trees grow around most of the ranch headquarters and farmsteads in Comanche County. They were planted at various times by the landowners after the headquarters were established. Siberian elm and eastern redcedar are the most common species in these windbreaks. Other species include green ash, honeylocust, northern catalpa, black locust, American elm, eastern cottonwood, Russian olive, Osageorange, hackberry, lilac, ponderosa pine, and eastern redbud.

Tree planting around the farmsteads is a continuing need because old trees pass maturity and deteriorate, because some trees are destroyed by insects, disease, or storms, and because new plantings are needed on expanding farmsteads. Supplemental planting is needed in many areas to restore the effectiveness of the windbreaks.

Many field windbreaks or shelterbelts are established in all parts of the county, except for the southeastern part. Most of the shelterbelts were planted as part of the Prairie States Forestry Project between 1935 and 1942. The shelterbelts vary greatly in size, row arrangement, and species. Some are made up of as many as 20 rows of trees and shrubs. The species include eastern redcedar, American plum, Siberian elm, eastern cottonwood, Russian mulberry, ponderosa pine, black locust, honeylocust, green ash, hackberry, western soapberry, common chokecherry, tamarisk, eastern redbud, Osageorange, northern catalpa, and desert willow. Eastern cottonwood is the dominant species in the windbreaks in areas of the Lincoln-Waldeck and Westview-Dale associations.

In order for windbreaks to fulfill their intended purpose, the soils on the site should be suited to the trees and shrubs selected for planting. Selecting suitable species for planting helps to ensure survival

Figure 16.—Timber claim planted to northern catalpa.

and a maximum growth rate. Permeability, available water capacity, fertility, texture, depth, and degree of wetness greatly affect the growth rate.

Establishing trees and shrubs is difficult in Comanche County because the amount of available moisture is limited. The main management needs are proper site preparation before the trees or shrubs are planted and measures that control competing weeds and grasses after the trees and shrubs are planted. Supplemental watering is necessary to provide moisture during periods when the windbreak is becoming established.

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The

plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 8 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 8 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

Comanche County has several areas of scenic, geologic, and historic interest. The rolling grasslands and wooded areas along streams add beauty and variety to the landscape. Farm ponds and streams provide opportunities for water sports. Lake Coldwater provides opportunities for camping, fishing, boating, and picnicking. Hunting for turkey, pheasant, quail, and deer is a popular activity. The potential for additional recreational development within the county is fair.

The soils of the survey area are rated in table 9 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 9, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 9 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 12 and interpretations for dwellings without basements and for local roads and streets in table 11.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils are gently sloping and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock should be considered.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Robert J. Higgins, biologist, Soil Conservation Service, helped prepare this section.

The primary game species in Comanche County are ring-necked pheasant, bobwhite quail, mourning dove, and white-tailed and mule deer. Several species of waterfowl also are hunted.

The Rio Grande turkey is well established in the

Figure 17.—Rio Grande turkeys in an area of Comanche County.

wooded areas along streams (fig. 17). It is a popular game bird. Some lesser prairie chickens and antelope inhabit the county.

Nongame species are numerous because of the many habitat types in the county. Cropland, woodland, and grassland are interspersed throughout the county, creating the desirable "edge" effect that is conducive to a variety of wildlife species. Each of these kinds of land provides a habitat for a particular group of species.

Furbearers inhabit the areas along streams. They are trapped on a limited basis.

Stockwater ponds, streams, and Lake Coldwater provide good to excellent opportunities for fishing. The species commonly caught are largemouth bass, bluegill, carp, channel cat, and bullhead catfish.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 10, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining

specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, grain sorghum, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are bluestems, grama grasses, switchgrass, indiangrass, western wheatgrass, goldenrod, broomweed, ragweed, sunflower, and native legumes.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of native shrubs are plum, dogwood, buckbrush, prairie rose, and sumac.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, cattail, indigobush, saltgrass, cordgrass, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl-feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include bobwhite quail, mourning dove, pheasant, meadowlark, field sparrow, and cottontail rabbit.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, redwing blackbirds, muskrat, and beaver.

Habitat for rangeland wildlife consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include coyotes, jackrabbits, mule deer, prairie dogs, antelope, prairie chickens, killdeer, and meadowlark.

Technical assistance in planning wildlife developments and in determining the vegetation suitable for planting in wildlife areas can be obtained from the local office of the Soil Conservation Service. Additional information and assistance can be obtained from the Kansas Fish and Game Commission and from the Cooperative Extension Service.

Engineering

John Eberwein, civil engineer, Soil Conservation Service, helped prepare this section

This section provides information for planning land

uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

Building Site Development

Table 11 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

Dwellings and small commercial buildings are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement

of footings. A high water table, depth to bedrock or to a cemented pan, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Sanitary Facilities

Table 12 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 12 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 12 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin

layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 12 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 13 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet, and the depth to the water table is less than 1 foot. These soils may have layers of suitable material, but the material is less than 3 feet thick.

Sand and gravel are natural aggregates suitable for commercial use with a minimum of processing. Sand and gravel are used in many kinds of construction. Specifications for each use vary widely. In table 13, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of

clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, bedrock, and toxic material.

Soils rated *good* have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer, and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel, stones, or soluble salts, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel, stones, or soluble salts, have slopes of more than 15 percent, or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 14 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas and for embankments, dikes, and levees. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, terraces and diversions, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders, organic matter, or salts or sodium. A high water table affects the amount of usable material. It also affects trafficability.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to bedrock, to a cemented pan, or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and potential frost action. Excavating and grading and the stability of ditchbanks are affected by depth to bedrock or to a cemented pan, large stones, slope, and the hazard of cutbanks caving. The productivity of the soil after drainage is adversely affected by extreme acidity or by toxic substances in the root zone, such as salts, sodium, or sulfur. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones and depth to bedrock or to a cemented pan. The performance of a system is affected by the depth of the root zone, the amount of salts or sodium, and soil reaction.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to reduce water erosion and conserve moisture by intercepting runoff. Slope, wetness, large stones, and depth to bedrock or to a cemented pan affect the construction of terraces and diversions. A restricted rooting depth, a severe hazard of soil blowing or water erosion, an excessively coarse texture, and restricted permeability adversely affect maintenance.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, slope, and depth to bedrock or to a cemented pan affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, toxic substances such as salts or sodium, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. These results are reported in table 18.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

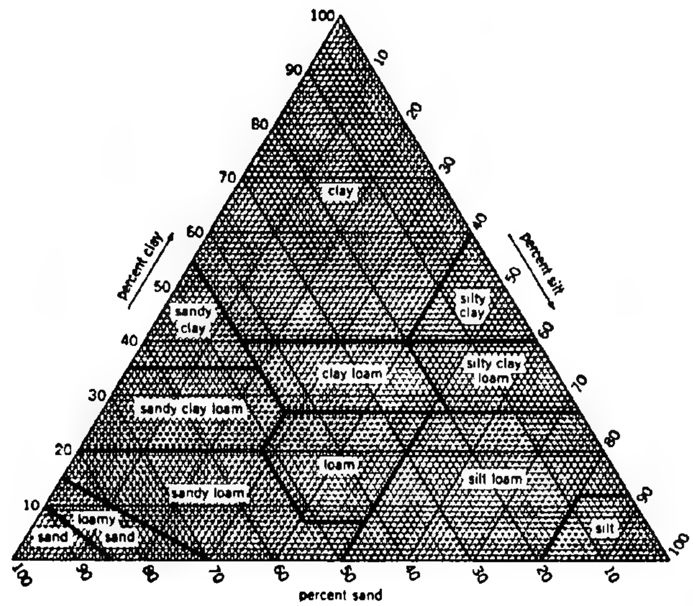

Figure 18.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 15 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 18). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the Glossary.

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and

clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments larger than 3 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 16 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓ bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Salinity is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous, loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Loamy soils that are less than 20 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5 percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Loamy soils that are 20 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to soil blowing.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 16, the estimated content of organic matter is expressed as a

percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 17 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the intake of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 17 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs, on the average, once or less in 2 years; and *frequent* that it occurs, on the average, more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and absence of distinctive horizons that form in soils that are not subject to flooding.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The depth to a seasonal high water table applies to undrained soils. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 17 are the depth to the seasonal high water table, the kind of water table, and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 17. An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Depth to bedrock is given if bedrock is within a depth of 5 feet. The depth is based on many soil borings and on observations during soil mapping. The rock is either soft or hard. If the rock is soft or fractured, excavations can be made with trenching machines, backhoes, or small rippers. If the rock is hard or massive, blasting or special equipment generally is needed for excavation.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and

electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors creates a severe corrosion environment. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and the amount of sulfates in the saturation extract.

Engineering Index Test Data

Table 18 shows laboratory test data for several pedons sampled at carefully selected sites in the survey area. The pedons are representative of the series described in the section "Soil Series and Their Morphology." The soil samples were tested by the Kansas Department of Transportation.

The testing methods generally are those of the American Association of State Highway and Transportation Officials (AASHTO) or the American Society for Testing and Materials (ASTM).

The tests and methods are AASHTO classification—M 145 (AASHTO), D 3282 (ASTM); Unified classification—D 2487 (ASTM); Mechanical analysis—T 88 (AASHTO), D 2217 (ASTM); Liquid limit—T 89 (AASHTO), D 423 (ASTM); Plasticity index—T 90 (AASHTO), D 424 (ASTM); and Moisture density, Method A—T 99 (AASHTO), D 698 (ASTM).

Classification of the Soils

The system of soil classification used by the National Cooperative Soil Survey has six categories *(6)*. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. Table 19 shows the classification of the soils in the survey area. The categories are defined in the following paragraphs.

ORDER. Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

SUBORDER. Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Fluvent (*Fluv*, meaning flood plain, plus *ent*, from Entisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Ustifluvents (*Ust*, meaning burnt, plus *fluvent*, the suborder of the Entisols that is on flood plains).

SUBGROUP. Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that typifies the great group. An example is Typic Ustifluvents.

FAMILY. Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Generally, the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is sandy, mixed, thermic Typic Ustifluvents.

SERIES. The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

Soil Series and Their Morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the *Soil Survey Manual (5)*. Many of the technical terms used in the descriptions are defined in *Soil Taxonomy (6)*. Unless otherwise stated, matrix colors in the descriptions are for dry soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Detailed Soil Map Units."

Abilene Series

The Abilene series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in calcareous old alluvium. Slope ranges from 0 to 3 percent.

Abilene soils are similar to Holdrege, St. Paul, and Westview soils and are commonly adjacent to Case and Clark soils. All of the similar and adjacent soils are lower on the landscape than Abilene soils. Also, Holdrege, St. Paul, and Westview soils contain less clay in the subsoil, and Case and Clark soils are shallower to calcareous material and do not have an argillic horizon.

Typical pedon of Abilene silt loam, 1 to 3 percent slopes, 1,200 feet south and 125 feet west of the northeast corner of sec. 8, T. 31 S., R. 18 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A—5 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; slightly hard, friable; neutral; clear smooth boundary.

BA—8 to 14 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; neutral; clear smooth boundary.

Bt1—14 to 24 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; moderate medium blocky structure parting to moderate fine blocky; very hard, firm; common distinct clay films on faces of peds; mildly alkaline; clear smooth boundary.

Bt2—24 to 35 inches; brown (10YR 5/3) silty clay, dark brown (10YR 4/3) moist; moderate medium blocky structure; very hard, firm; common distinct clay films on faces of peds; few films and small concretions of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

BCk—35 to 49 inches; pale brown (10YR 6/3) silty clay loam, brown (10YR 5/3) moist; weak medium blocky structure; hard, firm; common films and small concretions of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—49 to 60 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; massive; hard, friable; weak effervescence; moderately alkaline.

The depth to lime ranges from 16 to 28 inches. The mollic epipedon is more than 20 inches thick.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It typically is neutral or mildly alkaline. The Bt horizon has hue of 10YR or 7.5YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 or 3. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It is clay loam or silty clay loam.

Albion Series

The Albion series consists of deep, somewhat excessively drained soils on uplands. These soils formed in loamy sediments that are 20 to 40 inches deep over sandy alluvium. Permeability is moderately rapid in the solum and rapid in the substratum. Slope ranges from 1 to 15 percent.

Albion soils are similar to Canadian soils and are commonly adjacent to Case, Clark, and Shellabarger soils. Canadian soils have finer sand in the subsoil and substratum than the Albion soils. Case, Clark, and Shellabarger soils have a subsoil that is more clayey than that of the Albion soils. Also, they are higher on the landscape.

Typical pedon of Albion sandy loam, 1 to 4 percent slopes, 1,320 feet east and 510 feet north of the southwest corner of sec. 1, T. 32 S., R. 18 W.

A—0 to 8 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak medium granular structure; slightly hard, friable; common fine roots; slightly acid; gradual smooth boundary.

Bt—8 to 16 inches; strong brown (7.5YR 5/6) sandy loam, strong brown (7.5YR 4/6) moist; weak medium subangular blocky structure; hard, friable; few fine roots; few faint clay films on faces of peds; slightly acid; gradual smooth boundary.

BC—16 to 28 inches; reddish yellow (7.5YR 6/6) loamy sand, strong brown (7.5YR 5/6) moist; weak medium granular structure; slightly hard, very friable; few fine roots; neutral; gradual smooth boundary.

2C—28 to 60 inches; light yellowish brown (10YR 6/4) sand, yellowish brown (10YR 5/4) moist; single grained; loose; neutral.

The depth to sand or sand and gravel ranges from 20 to 40 inches. The content of gravel in the solum ranges from 0 to 15 percent. The mollic epipedon is 7 to 15 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is slightly

acid or medium acid. The Bt horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 6. It ranges from slightly acid to mildly alkaline. The 2C horizon has hue of 10YR or 7.5YR, value of 4 to 6 (4 or 5 moist), and chroma of 3 to 6. It is loamy sand, sand, or gravelly sand. It ranges from slightly acid to moderately alkaline.

Buttermilk Series

The Buttermilk series consists of deep, moderately well drained, moderately permeable, saline soils on stream terraces. These soils formed in silty alluvium. Slope is 0 to 1 percent.

Buttermilk soils are commonly adjacent to Carey, Clairemont, Dale, and Kingsdown soils. The adjacent soils are not saline. Carey and Kingsdown soils are on uplands. Clairemont soils do not have a mollic epipedon. They are on flood plains. Dale soils are in landscape positions similar to those of the Buttermilk soils.

Typical pedon of Buttermilk silt loam, 2,550 feet west and 400 feet south of the northeast corner of sec. 13, T. 34 S., R. 20 W.

A1—0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; mildly alkaline; clear smooth boundary.

A2—5 to 19 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; hard, friable; many fine roots; common fine white salt crystals; slightly saline; slight effervescence; moderately alkaline; gradual smooth boundary.

A3—19 to 28 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; hard, friable; few fine roots; common fine white salt crystals; slightly saline; strong effervescence; moderately alkaline; gradual smooth boundary.

Bw—28 to 44 inches; light brown (7.5YR 6/4) silt loam, brown (7.5YR 4/4) moist; weak medium subangular blocky structure; hard, friable; few fine roots; common fine white gypsum crystals; strong effervescence; moderately alkaline; gradual smooth boundary.

Cy—44 to 60 inches; pink (7.5YR 7/4) silt loam, light brown (7.5YR 6/4) moist; massive; hard, friable; many fine white gypsum crystals; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 20 to 40 inches. The depth to lime ranges from 0 to 20 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile. The soils are silt loam or silty clay loam throughout.

The A horizon has hue of 10YR to 5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The Bw horizon has hue of 10YR to 5YR, value of 5 or 6 (3 to 5 moist), and chroma of 2 to 6. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 4 to 6.

Canadian Series

The Canadian series consists of deep, well drained, moderately rapidly permeable soils on stream terraces. These soils formed in loamy alluvium. Slope ranges from 0 to 2 percent.

Canadian soils are similar to Albion soils and are commonly adjacent to Lincoln and Waldeck soils. Albion soils have an argillic horizon. The somewhat excessively drained Lincoln and somewhat poorly drained Waldeck soils are on flood plains. Lincoln soils formed in sandy alluvium.

Typical pedon of Canadian fine sandy loam, 1,320 feet east and 1,230 feet south of the northwest corner of sec. 28, T. 31 S., R. 17 W.

Ap—0 to 7 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak medium granular structure; soft, very friable; neutral; clear smooth boundary.

A—7 to 17 inches; dark grayish brown (10YR 4/2) fine sandy loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; soft, very friable; neutral; gradual smooth boundary.

Bw—17 to 27 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; moderate medium granular structure; slightly hard, very friable; mildly alkaline; gradual smooth boundary.

C—27 to 60 inches; pale brown (10YR 6/3) sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable; few threads of lime; slight effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 7 to 20 inches. The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It typically is slightly acid or neutral. The Bw horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 6. It typically is slightly acid to mildly alkaline. The C horizon has hue of 10YR or 7.5YR, value of 5 or 6 (4 or 5

moist), and chroma of 3 to 6. It typically is neutral to moderately alkaline. Some pedons are loamy fine sand below a depth of 40 inches.

Carey Series

The Carey series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from Permian red beds. Slope ranges from 0 to 5 percent.

Carey soils are similar to St. Paul and Westview soils and are commonly adjacent to Dale and Woodward soils. Dale, St. Paul, and Westview soils have a mollic epipedon that is more than 20 inches thick. Dale soils are lower on the landscape than the Carey soils. The moderately deep Woodward soils are higher on the landscape than the Carey soils.

Typical pedon of Carey silt loam, 0 to 2 percent slopes, 2,490 feet south and 1,980 feet west of the northeast corner of sec. 6, T. 35 S., R. 20 W.

A—0 to 10 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium granular structure; hard, friable; many fine roots; neutral; clear smooth boundary.

AB—10 to 15 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; hard, friable; many fine roots; few worm casts; neutral; clear smooth boundary.

Bt1—15 to 23 inches; brown (7.5YR 5/2) loam, dark brown (7.5YR 4/2) moist; weak medium subangular blocky structure; hard, friable; many fine roots; few faint clay films on faces of peds; many worm casts; slight effervescence; mildly alkaline; gradual smooth boundary.

Bt2—23 to 34 inches; light brown (7.5YR 6/4) clay loam, dark brown (7.5YR 4/4) moist; weak fine subangular blocky structure; hard, friable; few fine roots; few faint clay films on faces of peds; slight effervescence; mildly alkaline; gradual smooth boundary.

C—34 to 60 inches; light reddish brown (5YR 6/4) loam, reddish brown (5YR 5/4) moist; massive; hard, friable; strong effervescence; moderately alkaline.

The depth to lime ranges from 11 to 30 inches. The mollic epipedon is 10 to 20 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It typically is silt loam, but in some pedons it is loam. It is neutral or mildly alkaline. The Bt horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is loam, silty clay loam, or clay loam. It ranges from neutral to moderately alkaline. The C horizon has value of 4 to 6 (3 to 5 moist) and chroma of 4 to 6. It is loam or silt loam.

Case Series

The Case series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous, loamy old alluvium. Slope ranges from 1 to 15 percent.

Case soils are similar to Clark soils and are commonly adjacent to Abilene, Albion, and Clark soils. Abilene and Clark soils have a mollic epipedon. Abilene soils are in the higher, less sloping areas. Clark soils are in positions on the landscape similar to those of the Case soils. The noncalcareous Albion soils contain less clay in the subsoil than the Case soils. Also, they are lower on the landscape.

Typical pedon of Case clay loam, 7 to 15 percent slopes, 1,080 feet south and 330 feet west of the northeast corner of sec. 13, T. 31 S., R. 18 W.

A—0 to 8 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; moderate medium granular structure; hard, friable; common fine roots; few worm casts; few fine concretions of lime; slight effervescence; mildly alkaline; abrupt smooth boundary.

Bw—8 to 16 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, friable; common fine roots; numerous worm casts; fine concretions and threads of lime make up about 10 percent of the volume; strong effervescence; moderately alkaline; gradual smooth boundary.

BCk—16 to 27 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; moderate medium granular structure; hard, friable; few fine roots; concretions and threads of lime make up about 30 percent of the volume; violent effervescence; moderately alkaline; gradual smooth boundary.

C—27 to 60 inches; light brown (7.5YR 6/4) clay loam, brown (7.5YR 5/4) moist; massive; hard, friable; few concretions of lime; strong effervescence; moderately alkaline.

The soils are calcareous and mildly alkaline or moderately alkaline throughout. The A horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 or 3. It typically is clay loam, but the range includes loam and

fine sandy loam. The Bw and C horizons have hue of 10YR to 5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 4. They are clay loam or loam.

Clairemont Series

The Clairemont series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in calcareous, silty alluvium. Slope is 0 to 1 percent.

Clairemont soils are commonly adjacent to Dale, Port, Quinlan, and Woodward soils. Dale and Port soils have a mollic epipedon that is more than 20 inches thick. Dale soils are subject to rare flooding and are on stream terraces. Port soils are in positions on the landscape similar to those of the Clairemont soils. The shallow Quinlan soils and the moderately deep Woodward soils are on uplands.

Typical pedon of Clairemont silt loam, occasionally flooded, 2,200 feet west and 100 feet south of the northeast corner of sec. 19, T. 34 S., R. 19 W.

A—0 to 13 inches; reddish brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist; weak medium granular structure; slightly hard, very friable; mildly alkaline; gradual smooth boundary.

C1—13 to 25 inches; reddish brown (5YR 5/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate medium granular structure; slightly hard, friable; thin strata of coarser textured material less than 0.5 inch thick; few worm casts; slight effervescence; moderately alkaline; gradual smooth boundary.

C2—25 to 60 inches; red (2.5YR 5/6) silt loam, red (2.5YR 4/6) moist; massive; slightly hard, very friable; strong effervescence; moderately alkaline.

Reaction is mildly alkaline or moderately alkaline throughout the profile. Some pedons are calcareous throughout.

The A horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It is silt loam or loam. The C horizon has hue of 2.5YR to 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 4 to 6. It is dominantly silt loam, loam, or silty clay loam, but it commonly has strata of fine sandy loam less than 1 inch thick.

Clark Series

The Clark series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in calcareous, loamy old alluvium. Slope ranges from 0 to 12 percent.

Clark soils are similar to Case and Ost soils and are commonly adjacent to Abilene, Case, and Kingsdown soils. Abilene soils have an argillic horizon. They are in the higher, less sloping areas. Case soils do not have a mollic epipedon. They are in positions on the landscape similar to those of the Clark soils. Kingsdown soils contain less clay in the subsoil than the Clark soils. Also, they are higher on the landscape. Ost soils have an argillic horizon and are deeper to lime than the Clark soils.

Typical pedon of Clark clay loam, 1 to 3 percent slopes, 125 feet north and 50 feet west of the southeast corner of sec. 16, T. 31 S., R. 18 W.

A—0 to 10 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; slight effervescence; mildly alkaline; clear smooth boundary.

Bw—10 to 16 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable; many fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

BCk—16 to 24 inches; light yellowish brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) moist; weak medium subangular blocky structure; hard, friable; few fine roots; many fine concretions of lime; violent effervescence; moderately alkaline; gradual smooth boundary.

C—24 to 60 inches; very pale brown (10YR 7/4) clay loam, light yellowish brown (10YR 6/4) moist; massive; hard, friable; few fine concretions of lime; violent effervescence; moderately alkaline.

The soils are mildly alkaline or moderately alkaline throughout. The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 2 or 3. It typically is clay loam, but the range includes loam and fine sandy loam. The Bw and C horizons are clay loam or loam. The Bw horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. The C horizon has hue of 10YR to 5YR, value of 5 to 7 (4 to 6 moist), and chroma of 2 to 6.

Dale Series

The Dale series consists of deep, well drained, moderately permeable soils on stream terraces. These

soils formed in silty alluvium. Slope ranges from 0 to 2 percent.

Dale soils are similar to Elandco and Port soils and are commonly adjacent to Carey, Elandco, Lincoln, and Port soils. Carey soils have an argillic horizon. They are higher on the landscape than the Dale soils. Elandco and Port soils are on flood plains and are occasionally flooded. The somewhat excessively drained, sandy Lincoln soils also are on flood plains.

Typical pedon of Dale silt loam, 1,100 feet south and 1,400 feet east of the northwest corner of sec. 29, T. 33 S., R. 20 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; neutral; abrupt smooth boundary.

A—6 to 22 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak medium granular structure; slightly hard, friable; neutral; clear smooth boundary.

Bk—22 to 35 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure parting to moderate medium subangular blocky; hard, firm; common films and soft accumulations of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—35 to 60 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 4/3) moist; massive; hard, friable; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon and the depth to lime range from 20 to 40 inches. The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It typically is silt loam, but in some pedons it is silty clay loam. The Bk horizon has value of 3 to 5 (2 to 4 moist) and chroma of 2 or 3. It is silt loam or silty clay loam. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 or 4.

Elandco Series

The Elandco series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in calcareous, silty alluvium. Slope is 0 to 1 percent.

Elandco soils are similar to Dale and Port soils and are commonly adjacent to Case, Clark, and Dale soils. Case and Clark soils are on uplands. Case soils do not have a mollic epipedon. Clark soils have a mollic epipedon that is thinner than that of the Elandco soils. Dale soils are subject to rare flooding and are on stream terraces. Port soils are redder than the Elandco soils.

Typical pedon of Elandco silt loam, occasionally flooded, 1,120 feet east and 550 feet north of the center of sec. 3, T. 31 S., R. 18 W.

Ap—0 to 6 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; mildly alkaline; abrupt smooth boundary.

A1—6 to 20 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium granular structure; slightly hard, friable; many fine roots; mildly alkaline; gradual smooth boundary.

A2—20 to 31 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; slightly hard, friable; common fine roots; mildly alkaline; gradual smooth boundary.

C—31 to 60 inches; grayish brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) moist; massive; slightly hard, friable; few fine roots; strong effervescence; moderately alkaline.

The thickness of the mollic epipedon and the depth to lime range from 20 to 40 inches. The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It typically is silt loam, but in some pedons it is silty clay loam. It is neutral or mildly alkaline in the upper part and mildly alkaline or moderately alkaline in the lower part. The C horizon has value of 4 or 5 (3 or 4 moist) and chroma of 2 or 3. It is mildly alkaline or moderately alkaline.

Farnum Series

The Farnum series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loamy old alluvium. Slope ranges from 0 to 3 percent.

Farnum soils are similar to Ost soils and are commonly adjacent to Shellabarger soils. Ost soils have a mollic epipedon that is less than 20 inches thick and are shallower to lime than the Farnum soils. Shellabarger soils contain less clay in the subsoil than the Farnum soils. Also, they are lower on the landscape.

Typical pedon of Farnum loam, 1 to 3 percent slopes, 250 feet south and 150 feet east of the northwest corner of sec. 9, T. 32 S., R. 17 W.

Ap—0 to 5 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak medium granular structure; hard, friable; slightly acid; abrupt smooth boundary.

A—5 to 10 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; slightly acid; clear smooth boundary.

BA—10 to 16 inches; dark grayish brown (10YR 4/2) clay loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure; hard, firm; neutral; clear smooth boundary.

Bt1—16 to 26 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium prismatic structure parting to moderate medium blocky; very hard, firm; common distinct clay films on faces of peds; neutral; gradual smooth boundary.

Bt2—26 to 36 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium prismatic structure parting to moderate medium subangular blocky; very hard, firm; common distinct clay films on faces of some peds; mildly alkaline; clear smooth boundary.

BCk—36 to 54 inches; pale brown (10YR 6/3) clay loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; hard, firm; common films and soft accumulations of lime; slight effervescence; moderately alkaline; gradual smooth boundary.

C—54 to 60 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) moist; massive; hard, friable; slight effervescence; moderately alkaline.

The depth to lime ranges from 36 to more than 60 inches. The mollic epipedon ranges from 20 to 40 inches in thickness.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 2 or 3. It typically is loam, but in some pedons it is fine sandy loam. It typically is slightly acid or neutral. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is clay loam or sandy clay loam. It typically is slightly acid to mildly alkaline. The C horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 or 4. It is loam, clay loam, sandy clay loam, or fine sandy loam. It ranges from neutral to moderately alkaline.

Hedville Series

The Hedville series consists of shallow, somewhat excessively drained, moderately permeable soils on uplands. These soils formed in material weathered from sandstone. Slope ranges from 4 to 30 percent.

The Hedville soils in Comanche County are slightly warmer than is defined as the range for the series. This difference, however, does not significantly affect the use or behavior of the soils.

Hedville soils are commonly adjacent to Lancaster, Quinlan, and Wellsford soils. Lancaster soils are 20 to 40 inches deep over sandstone. They are on ridgetops and the lower side slopes. Quinlan soils are calcareous. They are lower on the landscape than the Hedville soils. Wellsford soils are clayey. They are higher on the landscape than the Hedville soils.

Typical pedon of Hedville fine sandy loam, in an area of Hedville-Rock outcrop complex, 8 to 30 percent slopes; 2,115 feet north and 180 feet east of the southwest corner of sec. 12, T. 31 S., R. 16 W.

A—0 to 11 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak medium granular structure; slightly hard, very friable; many fine roots; slightly acid; gradual smooth boundary.

Bw—11 to 19 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; moderate medium granular structure; slightly hard, very friable; many fine roots; slightly acid; abrupt wavy boundary.

R—19 inches; sandstone.

The depth to bedrock ranges from 4 to 20 inches. The solum ranges from medium acid to neutral.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It typically is fine sandy loam, but in some pedons it is loam. The Bw horizon, if it occurs, has hue of 10YR or 7.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It is fine sandy loam or loam.

Holdrege Series

The Holdrege series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in loess. Slope ranges from 1 to 3 percent.

The Holdrege soils in Comanche County are slightly warmer than is defined as the range for the series. This difference, however, does not significantly affect the use or behavior of the soils.

Holdrege soils are similar to Abilene soils and are commonly adjacent to Clark soils. Abilene soils have a subsoil that is more clayey than that of the Holdrege soils. Clark soils are shallower to calcareous material

than the Holdrege soils. They are on the steeper slopes below the Holdrege soils.

Typical pedon of Holdrege silt loam, 1 to 3 percent slopes, 1,550 feet west and 200 feet south of the northeast corner of sec. 3, T. 31 S., R. 20 W.

Ap—0 to 7 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, friable; slightly acid; abrupt smooth boundary.

BA—7 to 12 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; weak medium subangular blocky structure; hard, firm; few sand grains; slightly acid; clear smooth boundary.

Bt1—12 to 18 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; few faint clay films on faces of peds; few sand grains; neutral; clear smooth boundary.

Bt2—18 to 24 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; hard, firm; few faint clay films on faces of peds; neutral; clear smooth boundary.

BCk—24 to 29 inches; pale brown (10YR 6/3) silty clay loam, dark grayish brown (10YR 4/2) moist; weak medium subangular blocky structure; hard, friable; common films and soft accumulations of lime; strong effervescence; mildly alkaline; gradual smooth boundary.

C—29 to 44 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; massive; slightly hard, friable; common films of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

2C—44 to 60 inches; brown (10YR 5/3) loam, dark brown (10YR 3/3) moist; massive; slightly hard, friable; slight effervescence; moderately alkaline.

The depth to lime ranges from 20 to 36 inches. The A horizon has value of 4 or 5 (2 or 3 moist). It typically is silt loam, but the range includes loam and fine sandy loam. This horizon typically is slightly acid or neutral. The Bt horizon has value of 4 to 6 (3 to 5 moist) and chroma of 2 to 4. It typically is neutral or mildly alkaline. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4. It is mildly alkaline or moderately alkaline.

Kanza Series

The Kanza series consists of deep, poorly drained, rapidly permeable soils on flood plains. These soils formed in sandy alluvium. Slope is 0 to 1 percent.

Kanza soils are commonly adjacent to Lincoln, Waldeck, and Zenda soils. The somewhat excessively drained Lincoln soils are on the slightly higher flood plains upstream from the Kanza soils. The somewhat poorly drained Waldeck and Zenda soils are slightly higher on the flood plains than the Kanza soils. Also, they are less sandy.

Typical pedon of Kanza loamy fine sand, frequently flooded, 1,500 feet north and 2,210 feet west of the southeast corner of sec. 2, T. 33 S., R. 18 W.

A—0 to 10 inches; grayish brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; slightly acid; clear smooth boundary.

AC—10 to 20 inches; grayish brown (10YR 5/2) loamy fine sand, dark grayish brown (10YR 4/2) moist; common fine prominent strong brown (7.5YR 5/6) mottles; single grained; loose; neutral; gradual smooth boundary.

C—20 to 60 inches; very pale brown (10YR 7/3) sand, pale brown (10YR 6/3) moist; common coarse prominent strong brown (7.5YR 5/6) mottles; single grained; loose; moderately alkaline.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or less. It typically is loamy fine sand, but the range includes fine sandy loam and clay loam. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 1 to 3.

Kaski Series

The Kaski series consists of deep, well drained, moderately permeable soils on stream terraces. These soils formed in loamy alluvium. Slope ranges from 0 to 2 percent.

Kaski soils are commonly adjacent to the somewhat excessively drained Lincoln and somewhat poorly drained Waldeck soils on flood plains. The adjacent soils are more sandy than the Kaski soils.

Typical pedon of Kaski loam, 510 feet south and 90 feet west of the center of sec. 27, T. 31 S., R. 17 W.

A—0 to 22 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; numerous worm casts; slightly acid; gradual smooth boundary.

Bw—22 to 37 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; weak medium subangular

blocky structure; hard, friable; few worm casts; neutral; gradual smooth boundary.

C—37 to 60 inches; yellowish brown (10YR 5/4) loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable; mildly alkaline.

The thickness of the mollic epipedon ranges from 20 to 50 inches. The depth to lime ranges from 15 to more than 60 inches. The soils are loam or clay loam throughout.

The A horizon has value of 3 to 5 (2 or 3 moist) and chroma of 2 or 3. It typically is slightly acid or neutral. The Bw horizon has value of 3 to 6 (2 to 4 moist) and chroma of 2 or 3. It typically is neutral or mildly alkaline. The C horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 to 4. It typically is mildly alkaline or moderately alkaline.

Kingsdown Series

The Kingsdown series consists of deep, well drained, moderately rapidly permeable soils on uplands. These soils formed in loamy eolian deposits. Slope ranges from 0 to 7 percent.

Kingsdown soils are similar to Pratt soils and are commonly adjacent to Clark, Dale, and Pratt soils. Clark and Dale soils have more clay in the subsoil than the Kingsdown soils. Also, they are lower on the landscape. Pratt soils are sandy and noncalcareous. They are higher on the landscape than the Kingsdown soils.

Typical pedon of Kingsdown fine sandy loam, 0 to 2 percent slopes, 1,590 feet north and 30 feet west of the southeast corner of sec. 5, T. 34 S., R. 20 W.

A—0 to 10 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak medium granular structure; slightly hard, very friable; common fine roots; neutral; gradual smooth boundary.

Bw—10 to 24 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; slightly hard, very friable; common fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

C—24 to 60 inches; light yellowish brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) moist; massive; soft, very friable; few fine roots; slight effervescence; moderately alkaline.

The mollic epipedon ranges from 7 to 20 inches in thickness. The depth to carbonates ranges from 0 to 15 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It typically is fine sandy loam, but the range includes sandy loam, loamy fine sand, and loamy sand. This horizon typically is neutral or mildly alkaline. The Bw horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 or 4 moist), and chroma of 3 or 4. The C horizon has hue of 10YR or 7.5YR, value of 5 to 7 (4 to 6 moist), and chroma of 3 or 4.

Krier Series

The Krier series consists of deep, somewhat poorly drained, rapidly permeable, saline-alkali soils on flood plains. These soils formed in loamy material that is 10 to 20 inches deep over sandy alluvium. Slope is 0 to 1 percent.

Krier soils are commonly adjacent to the somewhat excessively drained Lincoln soils on the slightly higher flood plains.

Typical pedon of Krier loam, 1,410 feet north and 90 feet west of the southeast corner of sec. 2, T. 35 S., R. 20 W.

A—0 to 4 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine and medium roots; slight effervescence; moderately alkaline; clear smooth boundary.

C1—4 to 8 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; few fine prominent brown (7.5YR 4/4) mottles; weak medium subangular blocky structure; hard, friable; slight effervescence; moderately alkaline; clear smooth boundary.

C2—8 to 11 inches; light brownish gray (10YR 6/2) sandy loam, grayish brown (10YR 5/2) moist; common fine prominent yellowish brown (10YR 5/6) mottles; moderate medium granular structure; soft, very friable; few fine strata of grayish brown material; slight effervescence; moderately alkaline; gradual smooth boundary.

2C3—11 to 60 inches; very pale brown (10YR 7/3) sand, pale brown (10YR 6/3) moist; common fine prominent strong brown (7.5YR 5/8) mottles; single grained; loose; slight effervescence; moderately alkaline.

The depth to lime is 0 to 6 inches. Depth to the sandy part of the substratum ranges from 10 to 20 inches.

The A horizon has value of 4 or 5 (3 or 4 moist) and chroma of 1 or 2. It typically is loam, but the range includes sandy loam and clay loam. This horizon typically is mildly alkaline or moderately alkaline. The C

horizon has hue of 10YR or 2.5Y, value of 4 to 7 (4 or 5 moist), and chroma of 1 or 2. It is sandy loam, loam, or clay loam to a depth of at least 10 inches. It is moderately alkaline or strongly alkaline and is slightly saline or moderately saline. The 2C horizon has hue of 10YR or 2.5Y, value of 5 to 7 (4 to 6 moist), and chroma of 3 or 4. It is fine sand, sand, or coarse sand. It ranges from mildly alkaline to strongly alkaline.

Lancaster Series

The Lancaster series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from sandstone. Slope ranges from 4 to 12 percent.

The Lancaster soils in Comanche County are slightly warmer than is defined as the range for the series. This difference, however, does not significantly affect the use or behavior of the soils.

Lancaster soils are commonly adjacent to Hedville, Quinlan, Wellsford, and Woodward soils. Hedville soils are 4 to 20 inches deep over bedrock. They are on the steeper, upper side slopes. Wellsford soils are clayey. They are higher on the landscape than the Lancaster soils. Quinlan and Woodward soils are calcareous and are redder in the subsoil than the Lancaster soils. Also, they are lower on the landscape.

Typical pedon of Lancaster fine sandy loam, in an area of Lancaster-Hedville fine sandy loams, 4 to 12 percent slopes; 840 feet south and 2,400 feet west of the northeast corner of sec. 12, T. 31 S., R. 16 W.

A—0 to 10 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 3/3) moist; weak medium granular structure; slightly hard, very friable; many roots; slightly acid; gradual smooth boundary.

BA—10 to 16 inches; brown (7.5YR 5/4) fine sandy loam, dark brown (7.5YR 3/4) moist; weak fine subangular blocky structure; hard, friable; many roots; slightly acid; gradual smooth boundary.

Bt—16 to 24 inches; brown (7.5YR 5/4) sandy clay loam, dark brown (7.5YR 3/4) moist; moderate medium subangular blocky structure; hard, friable; few roots; few faint clay films on faces of peds; slightly acid; gradual smooth boundary.

BC—24 to 31 inches; reddish yellow (7.5YR 6/6) sandy loam, strong brown (7.5YR 4/6) moist; weak medium granular structure; slightly hard, very friable; slightly acid; clear wavy boundary.

Cr—31 inches; white (10YR 8/2), weathered sandstone.

The depth to bedrock ranges from 20 to 40 inches. The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It typically is fine sandy loam, but the range includes loam. The Bt horizon has hue of 10YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It is loam or sandy clay loam. It typically is slightly acid or neutral.

Lesho Series

The Lesho series consists of deep, somewhat poorly drained soils on flood plains. These soils formed in loamy sediments that are 20 to 40 inches deep over sandy alluvium. Permeability is moderately slow in the upper part of the profile and moderately rapid or rapid in the lower part. Slope ranges from 0 to 2 percent.

Lesho soils are similar to Zenda soils and are commonly adjacent to Lincoln and Waldeck soils. The somewhat excessively drained, sandy Lincoln soils are near stream channels. Waldeck and Zenda soils are more than 40 inches deep over sandy alluvium. They are in landscape positions similar to those of the Lesho soils.

Typical pedon of Lesho clay loam, occasionally flooded, 1,500 feet north and 750 feet west of the southeast corner of sec. 28, T. 33 S., R. 20 W.

A—0 to 10 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

AC—10 to 18 inches; grayish brown (10YR 5/2) clay loam, dark grayish brown (10YR 4/2) moist; moderate medium granular structure; hard, friable; many fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

C1—18 to 30 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; common fine prominent strong brown (7.5YR 5/6) mottles; moderate medium granular structure; hard, friable; strata of sandy loam and darker clay loam; few roots; slight effervescence; moderately alkaline; gradual smooth boundary.

2C2—30 to 60 inches; very pale brown (10YR 7/4) sand, light yellowish brown (10YR 6/4) moist; single grained; loose; slight effervescence; moderately alkaline.

The thickness of the solum and of the mollic epipedon ranges from 10 to 20 inches. Depth to the sandy part of the substratum ranges from 20 to 40 inches. The depth to lime is 0 to 6 inches. Reaction is mildly alkaline or moderately alkaline in the A and C horizons and mildly alkaline to strongly alkaline in the 2C horizon.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 2 or 3. It typically is clay loam, but in some pedons it is loam. The C horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It is clay loam or loam. The 2C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4.

Lincoln Series

The Lincoln series consists of deep, somewhat excessively drained, rapidly permeable soils on flood plains. These soils formed in sandy alluvium. Slope ranges from 0 to 2 percent.

Lincoln soils are commonly adjacent to Krier, Tivoli, Waldeck, and Yahola soils. The somewhat poorly drained Krier and Waldeck soils are in the lower positions on the landscape. The excessively drained Tivoli soils are on rolling and hilly uplands. Their sand is finer than that of the Lincoln soils. The well drained Yahola soils are farther from stream channels than the Lincoln soils. Also, they are not so sandy.

Typical pedon of Lincoln loamy sand, occasionally flooded, 200 feet south and 1,000 feet east of the northwest corner of sec. 20, T. 32 S., R. 17 W.

A—0 to 10 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) moist; weak medium granular structure; slightly hard, very friable; slight effervescence; moderately alkaline; gradual smooth boundary.

AC—10 to 22 inches; light yellowish brown (10YR 6/4) loamy sand, yellowish brown (10YR 5/4) moist; single grained; loose; thin strata of fine sandy loam less than 0.5 inch thick; slight effervescence; moderately alkaline; gradual smooth boundary.

C—22 to 60 inches; very pale brown (10YR 7/4) sand, light yellowish brown (10YR 6/4) moist; single grained; loose; few thin strata of fine sandy loam; slight effervescence; moderately alkaline.

The A horizon has value of 5 to 7 (3 to 5 moist) and chroma of 2 or 3. It typically is loamy sand, but the range includes sandy loam and loam. This horizon is mildly alkaline or moderately alkaline. The C horizon has hue of 10YR or 7.5YR, value of 6 or 7 (5 or 6 moist), and chroma of 3 or 4. It commonly has strata of fine sandy loam to clay loam less than 1 inch thick.

Obaro Series

The Obaro series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from fine grained sandstone. Slope ranges from 5 to 15 percent.

Obaro soils are commonly adjacent to Quinlan and Woodward soils. The adjacent soils are higher or lower on the landscape than the Obaro soils. Quinlan soils are less than 20 inches deep over bedrock. Woodward soils have a subsoil that is less clayey than that of the Obaro soils.

Typical pedon of Obaro silty clay loam, 5 to 12 percent slopes, 1,740 feet west of the northeast corner of sec. 2, T. 33 S., R. 16 W.

A—0 to 7 inches; reddish brown (5YR 5/3) silty clay loam, dark reddish brown (5YR 3/3) moist; weak fine granular structure; hard, friable; many fine roots; slight effervescence; moderately alkaline; clear smooth boundary.

Bw1—7 to 17 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/3) moist; weak fine subangular blocky structure; hard, friable; common fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

Bw2—17 to 35 inches; reddish brown (2.5YR 5/4) silty clay loam, reddish brown (2.5YR 4/4) moist; weak fine subangular blocky structure; hard, firm; common fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

Cr—35 to 60 inches; reddish brown (2.5YR 5/4), fine grained sandstone.

The solum is silty clay loam, clay loam, or loam. The A horizon has value of 4 or 5 (3 or 4 moist) and chroma of 3 or 4. The Bw horizon has hue of 2.5YR or 5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 to 6.

Ost Series

The Ost series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in calcareous old alluvium. Slope ranges from 2 to 6 percent.

Ost soils are similar to Clark and Farnum soils and are commonly adjacent to Case soils. Case soils do not have a mollic epipedon. They are on the lower side slopes. Clark soils do not have an argillic horizon and are shallower to lime than the Ost soils. Farnum soils have a mollic epipedon that is more than 20 inches thick and are deeper to lime than the Ost soils.

Typical pedon of Ost clay loam, 2 to 6 percent slopes, 725 feet east and 100 feet north of the southwest corner of sec. 5, T. 35 S., R. 18 W.

A—0 to 8 inches; dark grayish brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) moist;

moderate medium granular structure; hard, friable; many fine and medium roots; neutral; clear smooth boundary.

Bt1—8 to 16 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; moderate fine subangular blocky structure; hard, firm; clay films on faces of peds; many fine and medium roots; mildly alkaline; clear smooth boundary.

Bt2—16 to 22 inches; reddish brown (5YR 5/3) clay loam, reddish brown (5YR 4/3) moist; moderate medium subangular blocky structure; hard, firm; clay films on faces of some peds; common fine roots; strong effervescence; moderately alkaline; clear smooth boundary.

BCk—22 to 40 inches; reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, friable; few fine roots; common films and soft accumulations of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—40 to 60 inches; reddish yellow (5YR 6/6) clay loam, yellowish red (5YR 5/6) moist; massive; hard, friable; few films and soft accumulations of lime; strong effervescence; moderately alkaline.

The depth to free carbonates ranges from 12 to 24 inches. The mollic epipedon is 10 to 18 inches thick.

The A horizon has hue of 10YR or 7.5YR, value of 3 to 5 (2 or 3 moist), and chroma of 1 or 2. It is dominantly clay loam, but in some pedons it is loam. It typically is neutral or mildly alkaline. The Bt horizon has hue of 10YR, 7.5YR, or 5YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 to 4. It is clay loam or loam. It ranges from neutral to moderately alkaline. The C horizon has hue of 5YR or 7.5YR, value of 6 or 7 (5 or 6 moist), and chroma of 4 to 6. It is clay loam, loam, or sandy clay loam.

Port Series

The Port series consists of deep, well drained, moderately permeable soils on flood plains. These soils formed in calcareous, silty alluvium. Slope ranges from 0 to 2 percent.

Port soils are similar to Dale and Elandco soils and are commonly adjacent to Clairemont and Dale soils. Clairemont soils do not have a mollic epipedon. They are in landscape positions similar to those of the Port soils. Dale soils regularly decrease in content of organic matter with increasing depth. They are on rarely flooded stream terraces above the Port soils. Elandco soils are less red than the Port soils.

Typical pedon of Port silt loam, occasionally flooded, 1,740 feet south and 1,080 feet east of the northwest corner of sec. 17, T. 34 S., R. 19 W.

Ap—0 to 10 inches; dark reddish gray (5YR 4/2) silt loam, dark reddish brown (5YR 3/2) moist; weak medium granular structure; hard, friable; many medium and fine roots; neutral; abrupt smooth boundary.

A—10 to 23 inches; reddish brown (5YR 5/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate medium granular structure; hard, friable; many medium and fine roots; few worm casts; neutral; gradual smooth boundary.

Bw—23 to 34 inches; reddish brown (5YR 5/4) silty clay loam, dark reddish brown (5YR 3/4) moist; weak medium subangular blocky structure; hard, friable; few medium and fine roots; few worm casts; slight effervescence; mildly alkaline; gradual smooth boundary.

C—34 to 60 inches; red (2.5YR 5/6) silty clay loam, red (2.5YR 4/6) moist; massive; hard, friable; few threads of lime; strong effervescence; moderately alkaline.

The depth to lime and the thickness of the mollic epipedon range from 20 to 40 inches. The soils are silty clay loam, silt loam, or loam throughout.

The A horizon has hue of 5YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It typically is neutral or mildly alkaline. The Bw horizon has hue of 5YR or 2.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It typically is mildly alkaline or moderately alkaline. The C horizon has hue of 2.5YR or 5YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 to 6.

Pratt Series

The Pratt series consists of deep, well drained, rapidly permeable soils on uplands. These soils formed in sandy eolian deposits. Slope ranges from 1 to 15 percent.

Pratt soils are similar to Kingsdown soils and are commonly adjacent to Kingsdown and Tivoli soils. Kingsdown soils have a loamy subsoil. They are lower on the landscape than the Pratt soils. The excessively drained Tivoli soils are on ridges above the Pratt soils. They do not have an argillic horizon.

Typical pedon of Pratt loamy fine sand, undulating, 840 feet east and 900 feet south of the northwest corner of sec. 35, T. 31 S., R. 18 W.

A—0 to 9 inches; brown (10YR 5/3) loamy fine sand, dark brown (10YR 4/3) moist; weak medium granular structure; soft, very friable; neutral; gradual smooth boundary.

Bt—9 to 31 inches; brown (7.5YR 5/4) loamy fine sand, dark brown (7.5YR 4/4) moist; weak medium subangular blocky structure; slightly hard, very friable; faint clay bridges between sand grains; neutral; gradual smooth boundary.

C—31 to 60 inches; reddish yellow (7.5YR 6/6) loamy fine sand, strong brown (7.5YR 5/6) moist; single grained; loose; neutral.

The soils are medium acid to neutral throughout. The A horizon has value of 5 or 6 (4 or 5 moist) and chroma of 2 or 3. It typically is loamy fine sand, but the range includes fine sand, sand, and loamy sand. The Bt and C horizons have hue of 7.5YR or 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 3 to 6. The Bt horizon is loamy fine sand or loamy sand. The C horizon is loamy fine sand or fine sand.

Quinlan Series

The Quinlan series consists of shallow, well drained, moderately permeable soils on uplands. These soils formed in material weathered from soft, calcareous, fine grained sandstone. Slope ranges from 3 to 30 percent.

Quinlan soils are similar to Woodward soils and are commonly adjacent to Hedville, Lancaster, and Woodward soils. Hedville and Lancaster soils are noncalcareous. They are higher on the landscape than the Quinlan soils. Woodward soils are 20 to 40 inches deep over bedrock.

Typical pedon of Quinlan loam, in an area of Quinlan-Woodward loams, 6 to 15 percent slopes; 1,170 feet south and 180 feet west of the northeast corner of sec. 9, T. 34 S., R. 19 W.

A—0 to 7 inches; yellowish red (5YR 5/6) loam, yellowish red (5YR 4/6) moist; weak medium granular structure; slightly hard, friable; many fine roots; slight effervescence; mildly alkaline; gradual smooth boundary.

Bw—7 to 14 inches; red (2.5YR 5/6) loam, red (2.5YR 4/6) moist; weak medium subangular blocky structure; slightly hard, friable; many fine roots; strong effervescence; moderately alkaline; gradual wavy boundary.

Cr—14 inches; red (2.5YR 5/6), weakly cemented, calcareous sandstone.

The depth to bedrock ranges from 10 to 20 inches. The solum is mildly alkaline or moderately alkaline.

The A horizon has hue of 5YR or 2.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6. It typically is loam, but the range includes fine sandy loam and silt loam. The Bw horizon has hue of 2.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 4 to 6.

St. Paul Series

The St. Paul series consists of deep, well drained, moderately slowly permeable soils on uplands. These soils formed in silty red beds. Slope ranges from 0 to 3 percent.

St. Paul soils are similar to Abilene, Carey, and Westview soils and are commonly adjacent to Quinlan and Woodward soils. Abilene soils contain more clay in the subsoil than the St. Paul soils. Carey soils have a mollic epipedon that is less than 20 inches thick. The shallow Quinlan soils and the moderately deep Woodward soils do not have a mollic epipedon. They are lower or higher on the landscape than the St. Paul soils. Westview soils are shallower to soft, powdery lime than the St. Paul soils.

Typical pedon of St. Paul silt loam, 1 to 3 percent slopes, 990 feet east and 330 feet south of the northwest corner of sec. 16, T. 34 S., R. 19 W.

A—0 to 8 inches; brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; hard, friable; many fine roots; neutral; gradual smooth boundary.

BA—8 to 14 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 3/2) moist; weak fine subangular blocky structure; hard, friable; many fine roots; few worm casts; neutral; gradual smooth boundary.

Bt1—14 to 22 inches; reddish brown (5YR 4/3) silty clay loam, dark reddish brown (5YR 3/3) moist; moderate medium subangular blocky structure; hard, friable; few fine roots; few faint clay films on faces of peds; few worm casts; mildly alkaline; gradual smooth boundary.

Bt2—22 to 32 inches; reddish brown (5YR 4/4) silty clay loam, dark reddish brown (5YR 3/4) moist; moderate medium subangular blocky structure; hard, friable; few faint clay films on faces of peds; few films of lime in the lower part; slight effervescence; mildly alkaline; gradual smooth boundary.

BCk—32 to 40 inches; reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, friable; few films and soft accumulations of lime; strong

effervescence; mildly alkaline; gradual smooth boundary.

C—40 to 60 inches; yellowish red (5YR 5/6) silt loam, yellowish red (5YR 4/6) moist; massive; slightly hard, friable; few fine soft accumulations of lime; moderately alkaline.

The A horizon has hue of 10YR or 7.5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. The Bt horizon has hue of 5YR or 7.5YR, value of 4 or 5 (3 or 4 moist), and chroma of 2 to 4. The C horizon has hue of 5YR or 2.5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 to 6.

Shellabarger Series

The Shellabarger series consists of deep, well drained, moderately permeable soils on uplands. These soils formed in old alluvium. Slope ranges from 0 to 15 percent.

Shellabarger soils are commonly adjacent to Albion and Farnum soils. Albion soils contain less clay in the subsoil than the Shellabarger soils. Also, they are lower on the landscape. Farnum soils contain more clay in the subsoil than the Shellabarger soils. Also, they are higher on the landscape.

Typical pedon of Shellabarger sandy loam, 3 to 6 percent slopes, 2,220 feet south and 1,830 feet west of the northeast corner of sec. 13, T. 31 S., R. 17 W.

A—0 to 11 inches; brown (7.5YR 5/2) sandy loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; slightly hard, friable; many fine roots; medium acid; gradual smooth boundary.

BA—11 to 17 inches; reddish brown (5YR 5/4) sandy clay loam, reddish brown (5YR 4/4) moist; weak medium subangular blocky structure; hard, friable; many fine roots; slightly acid; gradual smooth boundary.

Bt—17 to 38 inches; reddish yellow (5YR 6/6) sandy clay loam, yellowish red (5YR 5/6) moist; weak medium subangular blocky structure; hard, friable; common fine roots; few faint clay films on faces of peds; slightly acid; gradual smooth boundary.

C—38 to 60 inches; reddish yellow (7.5YR 6/6) sandy loam, strong brown (7.5YR 5/6) moist; massive; hard, very friable; slight effervescence; mildly alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The A horizon has hue of 10YR to 5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It typically is sandy loam, but the range includes fine sandy loam, loam, and loamy sand. This horizon typically is slightly acid or medium acid. The Bt horizon has value of 4 to 6 (3 to 5 moist) and chroma of 3 to 6. It is sandy clay loam or sandy loam. It typically is slightly acid or neutral. The C horizon has hue of 7.5YR or 5YR, value of 5 or 6 (4 or 5 moist), and chroma of 4 to 6. It ranges from slightly acid to moderately alkaline. It is sandy loam, fine sandy loam, or coarse sandy loam. Some pedons are loamy sand, sand, or coarse sand below a depth of 40 inches.

Tivoli Series

The Tivoli series consists of deep, excessively drained, rapidly permeable soils on uplands. These soils formed in sandy eolian deposits. Slope ranges from 5 to 30 percent.

Tivoli soils are commonly adjacent to Lincoln and Pratt soils. Lincoln soils are on flood plains. Their sand is coarser than that of the Tivoli soils. Pratt soils have an argillic horizon. They are on the lower side slopes.

Typical pedon of Tivoli fine sand, hilly, 400 feet west and 100 feet south of the northeast corner of sec. 22, T. 32 S., R. 20 W.

A—0 to 6 inches; brown (10YR 5/3) fine sand, dark brown (10YR 4/3) moist; single grained; loose; many fine roots; neutral; gradual smooth boundary.

C—6 to 60 inches; light yellowish brown (10YR 6/4) fine sand, yellowish brown (10YR 5/4) moist; single grained; loose; roots decrease in abundance with increasing depth; neutral.

The soils range from slightly acid to moderately alkaline throughout. The A horizon has value of 4 to 6 (4 or 5 moist) and chroma of 2 to 4. It is fine sand or loamy fine sand. The C horizon has hue of 7.5YR or 10YR, value of 5 to 7 (4 to 6 moist), and chroma of 3 to 6.

Waldeck Series

The Waldeck series consists of deep, somewhat poorly drained, moderately rapidly permeable soils on flood plains. These soils formed in loamy and sandy alluvium. Slope ranges from 0 to 2 percent.

Waldeck soils are commonly adjacent to Kanza, Lesho, Lincoln, and Zenda soils. The poorly drained, sandy Kanza soils are on the slightly lower flood plains. Lesho and Zenda soils are in positions on the landscape similar to those of the Waldeck soils. Lesho soils have a solum that is more clayey than that of the Waldeck soils. Zenda soils are more clayey throughout

than the Waldeck soils. The somewhat excessively drained, sandy Lincoln soils are on the slightly higher flood plains.

Typical pedon of Waldeck fine sandy loam, occasionally flooded, 1,650 feet west and 135 feet south of the northeast corner of sec. 26, T. 31 S., R. 20 W.

A—0 to 13 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; slightly hard, very friable; slight effervescence; mildly alkaline; gradual smooth boundary.

AC—13 to 26 inches; brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) moist; few fine distinct brownish yellow (10YR 6/6) mottles below a depth of 20 inches; weak medium granular structure; slightly hard, very friable; slight effervescence; mildly alkaline; gradual smooth boundary.

C—26 to 48 inches; yellowish brown (10YR 5/4) fine sandy loam, dark yellowish brown (10YR 4/4) moist; common fine distinct brownish yellow (10YR 6/6) mottles; massive; slightly hard, friable; slight effervescence; mildly alkaline; gradual smooth boundary.

2C—48 to 60 inches; very pale brown (10YR 7/3) sand, pale brown (10YR 6/3) moist; single grained; loose; slight effervescence; moderately alkaline.

The thickness of the mollic epipedon ranges from 10 to 20 inches. The depth to lime ranges from 0 to 12 inches. Depth to the sandy part of the substratum is more than 40 inches. Reaction is mildly alkaline or moderately alkaline throughout the profile.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 or 2. It typically is fine sandy loam, but in some pedons it is loam. The C horizon has hue of 7.5YR or 10YR, value of 5 or 6 (4 or 5 moist), and chroma of 2 to 4. It is sandy loam or fine sandy loam. The 2C horizon is fine sand or sand.

Wellsford Series

The Wellsford series consists of shallow, well drained, very slowly permeable soils on uplands. These soils formed in material weathered from shale. Slope ranges from 6 to 25 percent.

Wellsford soils are commonly adjacent to Clark, Hedville, and Lancaster soils. Clark soils are higher on the landscape than the Wellsford soils. They have a loamy subsoil and are more than 40 inches deep over bedrock. Hedville and Lancaster soils are lower on the landscape than the Wellsford soils. Hedville soils are loamy. Lancaster soils are 20 to 40 inches deep over sandstone.

Typical pedon of Wellsford clay, 6 to 25 percent slopes, 450 feet south of the northwest corner of sec. 4, T. 31 S., R. 16 W.

A—0 to 5 inches; grayish brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) moist; weak fine granular structure; hard, firm; common fine roots; slight effervescence in the lower part; moderately alkaline; gradual smooth boundary.

Bw—5 to 17 inches; olive (5Y 5/3) clay, olive (5Y 4/3) moist; moderate medium blocky structure; very hard, very firm; few fine roots; few fragments of sandstone less than 2 inches across; few concretions of lime 2 to 5 millimeters in diameter; strong effervescence; moderately alkaline; gradual smooth boundary.

Cr—17 inches; dark grayish brown (2.5Y 4/2), clayey shale.

The depth to bedrock ranges from 10 to 20 inches. The solum is clay, clay loam, or silty clay. Ironstone, limestone, or sandstone fragments cover 0 to 15 percent of the surface.

The A horizon has hue of 5Y to 10YR, value of 4 to 6 (4 or 5 moist), and chroma of 2 to 4. The Bw horizon has hue of 5Y to 10YR, value of 4 to 6 (4 or 5 moist), and chroma of 2 to 6. In some pedons it has brownish yellow to olive brown relict mottles.

Westview Series

The Westview series consists of deep, well drained, moderately slowly permeable soils on ancient terraces. These soils formed in calcareous, silty alluvium or in alluvium and loess. Slope is 0 to 1 percent.

Westview soils are similar to Abilene, Carey, and St. Paul soils and are commonly adjacent to Carey, Clark, Dale, and Port soils. Abilene soils have a subsoil that is more clayey than that of the Westview soils. Carey and Clark soils have a mollic epipedon that is less than 20 inches thick. They are on uplands. Dale and Port soils do not have a Bt horizon. They are lower on the landscape than the Westview soils. St. Paul soils are deeper to soft, powdery lime than the Westview soils.

Typical pedon of Westview silt loam, 0 to 1 percent slopes, 1,320 feet west and 50 feet south of the northeast corner of sec. 28, T. 33 S., R. 20 W.

Ap—0 to 5 inches; brown (7.5YR 5/2) silt loam, dark brown (7.5YR 3/2) moist; weak fine granular

structure; slightly hard, friable; neutral; abrupt smooth boundary.

A—5 to 15 inches; brown (7.5YR 4/2) silt loam, dark brown (7.5YR 3/2) moist; weak medium granular structure; slightly hard, friable; mildly alkaline; clear smooth boundary.

BA—15 to 22 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 3/2) moist; weak medium subangular blocky structure; hard, friable; strong effervescence; moderately alkaline; clear smooth boundary.

Bt—22 to 30 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate medium subangular blocky structure; hard, firm; few fine soft accumulations of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

BC—30 to 50 inches; light reddish brown (5YR 6/3) silty clay loam, dark reddish gray (5YR 4/2) moist; moderate medium subangular blocky structure; hard, firm; common fine and medium soft accumulations of lime; strong effervescence; moderately alkaline; gradual smooth boundary.

C—50 to 60 inches; light reddish brown (5YR 6/3) silty clay loam, reddish brown (5YR 4/3) moist; massive; hard, firm; few fine soft accumulations of lime; strong effervescence; moderately alkaline.

The depth to soft, powdery secondary lime ranges from 15 to 30 inches. The mollic epipedon ranges from 20 to 40 inches in thickness.

The A horizon has hue of 7.5YR or 5YR, value of 4 or 5 (2 or 3 moist), and chroma of 2 or 3. It is dominantly silt loam, but in some pedons it is loam. It ranges from neutral to moderately alkaline. The Bt horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 4. It is silty clay loam or clay loam. It is mildly alkaline or moderately alkaline. The C horizon has value of 4 to 6 (3 to 5 moist) and chroma of 3 to 6. It is silty clay loam, clay loam, or loam.

Woodward Series

The Woodward series consists of moderately deep, well drained, moderately permeable soils on uplands. These soils formed in material weathered from soft, calcareous, fine grained sandstone. Slope ranges from 1 to 20 percent.

Woodward soils are similar to Quinlan soils and are commonly adjacent to Carey, Hedville, Lancaster, and Quinlan soils. Carey soils are more than 40 inches deep over bedrock. They are lower on the landscape than the Woodward soils. Hedville and Lancaster soils are noncalcareous and are browner than the Woodward soils. Also, they are higher on the landscape. Quinlan soils are 10 to 20 inches deep over sandstone.

Typical pedon of Woodward loam, in an area of Woodward-Quinlan loams, 3 to 6 percent slopes; 1,410 feet west and 105 feet north of the southeast corner of sec. 17, T. 34 S., R. 19 W.

A—0 to 7 inches; reddish brown (5YR 4/3) loam, dark reddish brown (5YR 3/3) moist; weak medium granular structure; slightly hard, friable; many fine and medium roots; mildly alkaline; gradual smooth boundary.

Bw—7 to 18 inches; reddish brown (5YR 5/4) loam, reddish brown (5YR 4/4) moist; moderate medium granular structure; slightly hard, friable; many fine and medium roots; common worm casts; strong effervescence; moderately alkaline; gradual smooth boundary.

BC—18 to 30 inches; red (2.5YR 4/6) loam, dark red (2.5YR 3/6) moist; weak medium granular structure; slightly hard, friable; few fine roots; strong effervescence; moderately alkaline; gradual smooth boundary.

Cr—30 inches; red (2.5YR 5/8), weakly cemented, calcareous sandstone.

The depth to bedrock ranges from 20 to 40 inches. The depth to lime ranges from 0 to 10 inches. The solum is loam or silt loam.

The A horizon has hue of 5YR or 7.5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 or 4. In areas where it has value of less than 3.5 when moist, this horizon has an organic matter content of less than 1 percent. The Bw horizon has hue of 2.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 3 to 6.

Yahola Series

The Yahola series consists of deep, well drained, moderately rapidly permeable soils on flood plains. These soils formed in calcareous, loamy and sandy alluvium. Slope ranges from 0 to 2 percent.

Yahola soils are commonly adjacent to the somewhat excessively drained, sandy Lincoln soils. They are farther from stream channels than the Lincoln soils.

Typical pedon of Yahola fine sandy loam, occasionally flooded, 1,050 feet east and 850 feet south of the northwest corner of sec. 13, T. 34 S., R. 17 W.

Ap—0 to 5 inches; brown (7.5YR 5/4) fine sandy loam, reddish brown (5YR 4/3) moist; weak fine granular

structure; slightly hard, very friable; slight effervescence; moderately alkaline; abrupt smooth boundary.

A—5 to 12 inches; brown (7.5YR 5/4) fine sandy loam, reddish brown (5YR 4/3) moist; weak medium granular structure; slightly hard, very friable; strong effervescence; moderately alkaline; gradual smooth boundary.

C—12 to 40 inches; brown (7.5YR 5/4) fine sandy loam, reddish brown (5YR 4/4) moist; massive; slightly hard, very friable; few strata of coarser or finer textured material; strong effervescence; moderately alkaline; gradual smooth boundary.

2C—40 to 60 inches; pink (7.5YR 7/4) loamy fine sand, light brown (7.5YR 6/4) moist; single grained; loose; slight effervescence; moderately alkaline.

The A horizon has hue of 7.5YR or 5YR, value of 4 to 6 (3 to 5 moist), and chroma of 2 to 6. It typically is fine sandy loam, but in some pedons it is loam. The C horizon has hue of 7.5YR or 5YR, value of 4 to 7 (4 to 6 moist), and chroma of 3 to 6.

Zenda Series

The Zenda series consists of deep, somewhat poorly drained, moderately permeable soils on flood plains. These soils formed in loamy alluvium. Slope ranges from 0 to 2 percent.

Zenda soils are similar to Lesho soils and are commonly adjacent to Kanza and Waldeck soils. The poorly drained, sandy Kanza soils are on the slightly lower flood plains. Lesho soils are 20 to 40 inches deep over sandy alluvium. Waldeck soils are less clayey than the Zenda soils. They are in positions on the landscape similar to those of the Zenda soils.

Typical pedon of Zenda clay loam, occasionally flooded, 2,600 feet east and 250 feet north of the southwest corner of sec. 36, T. 32 S., R. 20 W.

Ap—0 to 6 inches; brown (10YR 5/3) clay loam, dark brown (10YR 3/3) moist; weak medium granular structure; hard, friable; slight effervescence; mildly alkaline; abrupt smooth boundary.

A—6 to 12 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium granular structure; hard, friable; slight effervescence; mildly alkaline; clear smooth boundary.

C1—12 to 25 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak medium granular structure; hard, friable; strong effervescence; moderately alkaline; clear smooth boundary.

C2—25 to 60 inches; light gray (10YR 7/2) clay loam, pale brown (10YR 6/3) moist; common medium prominent strong brown (7.5YR 5/6) mottles; stratified with thin bands of fine sandy loam; massive; hard, friable; violent effervescence; moderately alkaline.

The mollic epipedon is 10 to 20 inches thick. The depth to lime ranges from 0 to 20 inches.

The A horizon has value of 4 or 5 (2 or 3 moist) and chroma of 1 to 3. It typically is clay loam, but in some pedons it is loam. It typically is mildly alkaline or moderately alkaline. The C horizon has value of 5 to 7 (4 to 6 moist) and chroma of 2 to 4.

Formation of the Soils

Soil forms through processes that act on deposited or accumulated geologic material. The characteristics of a soil at any given point are determined by the interaction of five factors of soil formation: parent material, climate, plants and other living organisms, relief, and time. Each of these factors influences the formation of every soil, and each modifies the effects of the other four. The relative effects of the individual factors vary from place to place. The interactions among these factors are more complex for some soils than for others.

Parent Material

Parent material is the unconsolidated material in which soils form. It either is material weathered from rocks through freezing and thawing, abrasion, erosion, or chemical processes or is material deposited by wind or water. The parent material affects texture, structure, color, natural fertility, and many other soil properties. Soils differ partly because of the various kinds of parent material. The texture of the parent material influences the rate of the downward movement of water and air and thus greatly affects soil formation. The composition of the parent material largely determines the mineralogical composition of the soil and, hence, its natural fertility. The soils in Comanche County formed in alluvium, loess, sandy and loamy eolian material, and sandstone and shale residuum.

Alluvium is water-deposited material. The county has both recent and old alluvial sediments. The recent alluvium is in stream valleys. Buttermilk, Canadian, Clairemont, Dale, Elandco, Kanza, Kaski, Krier, Lesho, Lincoln, Port, Waldeck, Yahola, and Zenda soils formed in this material. Old alluvial sediments are on what are now uplands. Abilene, Albion, Case, Clark, Farnum, Ost, and Shellabarger soils formed in these sediments.

Loess is silty, wind-deposited material, some of which was carried hundreds of miles from its source. Peorian Loess of the Wisconsin Glaciation, which covers some of the uplands in Comanche County, was deposited during the Pleistocene. In most areas it is very pale brown or light gray and is calcareous and friable. Holdrege soils formed in this material.

Sandy and loamy eolian material is deposited in some areas in the county, including sandhills and nearly level uplands. Kingsdown, Pratt, and Tivoli soils formed in eolian material.

Bedrock of the Permian and Cretaceous Systems crops out in Comanche County. The oldest geologic bedrock that is a source of parent material in the county is of the Permian System. This bedrock consists of the Blaine Formation, Dog Creek Shale, Whitehorse Sandstone, Day Creek Dolomite, and the Big Basin Formation. It occurs as reddish or grayish beds of shale, sandstone, and siltstone. Carey, Obaro, Quinlan, St. Paul, and Woodward soils formed in material weathered from calcareous sandstone and shale of the Permian System.

The Permian System is overlain by Cheyenne Sandstone and Kiowa Shale of the Cretaceous System. The Cheyenne Sandstone underlies the Kiowa Shale. It commonly is brown. Hedville and Lancaster soils formed in material weathered from this sandstone. The Kiowa Shale typically consists of gray, red, and brown, clayey shale in the upper part and thinly laminated, dark gray to black shale in the lower part. A conspicuous feature of this formation, especially in the lower part, is thin beds of shell limestone. Wellsford soils formed in material weathered from Kiowa Shale.

Climate

Climate is an active factor of soil formation. It directly affects soil formation by weathering the parent material. It indirectly influences soil formation through its effect on plants and animals. Soil-forming processes are most active when the soil is warm and moist.

The climate of Comanche County is typical continental. It is characterized by intermittent dry and moist periods, which can last for less than a year or for several years. The soil material dries to varying depths during the dry periods. It slowly regains moisture during the wet periods and can become so saturated that

excess moisture penetrates the substratum. Because of the wetting and drying, some of the basic nutrients, and even clay particles, have been leached from the upper horizons of the soils. An accumulation of lime in the lower part of the subsoil in Holdrege soils is an indication of leaching by excess moisture. The downward movement of water is a major factor in transforming the parent material into a soil that has distinct horizons.

Plant and Animal Life

Plants and animals have important effects on soil formation. Plants generally influence the content of nutrients and organic matter in the soil and the color of the surface layer. Earthworms, cicadas, and other burrowing animals help to keep the soil open and porous. Bacteria and fungi help to decompose the plants, thus releasing plant nutrients.

Mid and tall prairie grasses have influenced the soil formation in Comanche County. As a result of these grasses, the upper part of a typical soil in the county is dark and is high in content of organic matter. In many areas the next layer is slightly finer textured and somewhat lighter colored than the layer above. The underlying parent material generally is light in color.

Human activities have greatly affected soil formation. In most areas they have increased the susceptibility to erosion, have increased or decreased the content of organic matter, or have changed the relief by land leveling and by industrial and urban development.

Relief

Relief, or lay of the land, influences the formation of soils through its effect on drainage, runoff, plant cover, and soil temperature. It is important mainly because it controls the movement of water on the surface and into the soil.

Runoff is more rapid on the steeper upland soils than on the less sloping soils. As a result, erosion is more extensive. Lancaster and Hedville soils formed in old parent material, but relief has restricted their formation. Runoff is rapid on these moderately sloping to steep soils, and much of the soil material is removed as soon as a soil forms.

Soils in low areas where surface drainage is poor are likely to have a grayish or mottled subsoil. Examples are the somewhat poorly drained or poorly drained Kanza, Krier, Lesho, Waldeck, and Zenda soils.

Nearly level soils on bottom land and stream terraces, such as Dale, Elandco, and Kaski soils, receive runoff from the higher adjacent areas. The upper layers of these soils are thickened because the runoff deposits additional soil material.

Time

The length of time needed for soil formation depends largely on the other factors of soil formation. As water moves downward through the soil, soluble material and fine particles are gradually leached from the surface layer to the subsoil. The extent of leaching depends on the amount of time that has elapsed and the amount of water that has penetrated the surface.

Differences in the length of time that the parent material has been exposed to the processes of soil formation are reflected in the degree of profile development. For example, the young Lincoln soils, which formed in recent alluvium, show very little evidence of horizon development other than a slight darkening of the surface layer. In contrast, the older Holdrege soils, which have been exposed to soil-forming processes for thousands of years, have well defined horizons.

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Glossary

ABC soil. A soil having an A, a B, and a C horizon.

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates, such as granules, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Area reclaim (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

Argillic horizon. A subsoil horizon characterized by an accumulation of illuvial clay.

Association, soil. A group of soils geographically associated in a characteristic repeating pattern and defined and delineated as a single map unit.

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

Very low	0 to 3
Low	3 to 6
Moderate	6 to 9
High	9 to 12
Very high	more than 12

Base saturation. The degree to which material having cation-exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the total cation-exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to flooding.

Calcareous soil. A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Cation-exchange capacity. The total amount of exchangeable cations that can be held by the soil, expressed in terms of milliequivalents per 100 grams of soil at neutrality (pH 7.0) or at some other stated pH value. The term, as applied to soils, is synonymous with base-exchange capacity but is more precise in meaning.

Catsteps. Very small, irregular terraces on steep hillsides, especially in pasture, formed by the trampling of cattle or the slippage of saturated soil.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

Climax vegetation. The stabilized plant community on a particular site. The plant cover reproduces itself and does not change so long as the environment remains the same.

Coarse fragments. If round, mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter; if flat, mineral or rock particles (flagstone) 15 to 38 centimeters (6 to 15 inches) long.

Complex slope. Irregular or variable slope. Planning or constructing terraces, diversions, and other water-control measures on a complex slope is difficult.

Complex, soil. A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the

selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Conservation tillage. A tillage system that does not invert the soil and that leaves a protective amount of crop residue on the surface throughout the year.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Contour stripcropping. Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

Cutbanks cave (in tables). The walls of excavations tend to cave in or slough.

Decreasers. The most heavily grazed climax range plants. Because they are the most palatable, they are the first to be destroyed by overgrazing.

Deferred grazing. Postponing grazing or resting grazing land for a prescribed period.

Depth to rock (in tables). Bedrock is too near the surface for the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically they are wet long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously

saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

Excess fines (in tables). Excess silt and clay in the soil. The soil is not a source of gravel or sand for construction purposes.

Excess salts (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

Fallow. Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

Fast intake (in tables). The rapid movement of water into the soil.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity.*

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.6 centimeters) in diameter. An individual piece is a pebble.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. In the identification of soil horizons, an uppercase letter represents the major horizons. Numbers or lowercase letters that follow represent subdivisions of the major horizons. The major horizons are as follows:

O horizon.—An organic layer of fresh and decaying plant residue.

A horizon.—The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, any plowed or disturbed surface layer.

E horizon.—The mineral horizon in which the main feature is loss of silicate clay, iron, aluminum, or some combination of these.

B horizon.—The mineral horizon below an O, A, or E horizon. The B horizon is in part a layer of transition from the overlying horizon to the underlying C horizon. The B horizon also has distinctive characteristics, such as (1)

accumulation of clay, sesquioxides, humus, or a combination of these; (2) granular, prismatic, or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the overlying horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, an Arabic numeral, commonly a 2, precedes the letter C.

Cr horizon.—Soft, consolidated bedrock beneath the soil.

R layer.—Hard, consolidated bedrock beneath the soil. The bedrock commonly underlies a C horizon but can be directly below an A or a B horizon.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Increasers. Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Infiltration capacity. The maximum rate at which water can infiltrate into a soil under a given set of conditions.

Invaders. On range, plants that encroach into an area and grow after the climax vegetation has been reduced by grazing. Generally, invader plants follow disturbance of the surface.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Border.—Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

Basin.—Water is applied rapidly to nearly level plains surrounded by levees or dikes.

Controlled flooding.—Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

Corrugation.—Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

Drip (or trickle).—Water is applied slowly and under low pressure to the surface of the soil or into the soil through such applicators as emitters, porous tubing, or perforated pipe.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Subirrigation.—Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

Wild flooding.—Water, released at high points, is allowed to flow onto an area without controlled distribution.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Loess. Fine grained material, dominantly of silt-sized particles, deposited by wind.

Low strength. The soil is not strong enough to support loads.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Miscellaneous area. An area that has little or no natural soil and supports little or no vegetation.

Mollic epipedon. A thick, dark, humus-rich surface horizon (or horizons) that has high base saturation and pedogenic soil structure. It may include the upper part of the subsoil.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity,

consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of three simple variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3. (See Reaction, soil.)

Nutrient, plant. Any element taken in by a plant essential to its growth. Plant nutrients are mainly nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, and zinc obtained from the soil and carbon, hydrogen, and oxygen obtained from the air and water.

Organic matter. Plant and animal residue in the soil in various stages of decomposition.

Parent material. The unconsolidated organic and mineral material in which soil forms.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly (in tables). The slow movement of water through the soil, adversely affecting the specified use.

Permeability. The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	less than 0.06 inch
Slow	0.06 to 0.2 inch
Moderately slow	0.2 to 0.6 inch
Moderate	0.6 inch to 2.0 inches
Moderately rapid	2.0 to 6.0 inches
Rapid	6.0 to 20 inches
Very rapid	more than 20 inches

pH value. A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

Phase, soil. A subdivision of a soil series based on features that affect its use and management. For example, slope, stoniness, and thickness.

Piping (in tables). Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

Plastic limit. The moisture content at which a soil changes from semisolid to plastic.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Poor filter (in tables). Because of rapid permeability, the soil may not adequately filter effluent from a waste disposal system.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Proper grazing use. A grazing system that maintains enough plant cover to protect the soil and maintain or improve the quantity and quality of desirable vegetation.

Range condition. The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

Range site. An area of rangeland where climate, soil, and relief are sufficiently uniform to produce a distinct natural plant community. A range site is the product of all the environmental factors responsible for its development. It is typified by an association of species that differ from those on other range sites in kind or proportion of species or total production.

Rangeland. Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

Reaction, soil. A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The

degrees of acidity or alkalinity, expressed as pH values, are—

Extremely acid	below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Residuum (residual soil material). Unconsolidated, weathered or partly weathered mineral material that accumulated as consolidated rock disintegrated in place.

Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Seepage (in tables). The movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils that have profiles that are almost alike, except for differences in texture of the surface layer or of the substratum. All the soils of a series have horizons that are similar in composition, thickness, and arrangement.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Siltstone. Sedimentary rock made up of dominantly silt-sized particles.

Similar soils. Soils that share limits of diagnostic criteria, behave and perform in a similar manner, and have similar conservation needs or management requirements for the major land uses in the survey area.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slope (in tables). Slope is great enough that special practices are required to ensure satisfactory performance of the soil for a specific use.

Slow intake (in tables). The slow movement of water into the soil.

Small stones (in tables). Rock fragments less than 3 inches (7.6 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

Soil. A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes, in millimeters, of separates recognized in the United States are as follows:

Very coarse sand	2.0 to 1.0
Coarse sand	1.0 to 0.5
Medium sand	0.5 to 0.25
Fine sand	0.25 to 0.10
Very fine sand	0.10 to 0.05
Silt	0.05 to 0.002
Clay	less than 0.002

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A, E, and B horizons. Generally, the characteristics of the material in these horizons are unlike those of

the underlying material. The living roots and plant and animal activities are largely confined to the solum.

Stripcropping. Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to soil blowing and water erosion.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself, as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Stubble mulch. Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from soil blowing and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Any surface soil horizon (A, E, AB, or EB) below the surface layer.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

Surface layer. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from about 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Surface soil. The A, E, AB, and EB horizons. It includes all subdivisions of these horizons.

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use and behavior.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that water soaks into the soil or flows slowly to a prepared outlet.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thin layer (in tables). Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The physical condition of the soil as related to tillage, seedbed preparation, seedling emergence, and root penetration.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Tables

TABLE 1.--TEMPERATURE AND PRECIPITATION

(Recorded in the period 1951-80 at Coldwater, Kansas)

Month	Temperature: Average daily maximum	Temperature: Average daily minimum	Temperature: Average daily	Temperature: 2 years in 10 will have-- Maximum temperature higher than--	Temperature: 2 years in 10 will have-- Minimum temperature lower than--	Precipitation: Average	Precipitation: 2 years in 10 will have-- Less than--	Precipitation: 2 years in 10 will have-- More than--	Precipitation: Average number of days with 0.10 inch or more	Precipitation: Average snowfall
	°F	°F	°F	°F	°F	In	In	In		In
January----	44.2	19.7	32.0	73	-7	0.59	0.06	0.80	1	3.8
February---	50.9	24.6	37.8	84	0	.90	.18	1.30	2	4.0
March------	59.3	31.7	45.5	89	4	1.47	.18	2.05	3	3.6
April------	71.2	43.5	57.4	94	19	1.77	.70	3.00	3	.9
May--------	80.1	53.5	66.8	101	33	3.43	1.50	4.65	6	T*
June-------	89.9	62.9	76.4	106	45	3.99	1.50	5.15	6	.0
July-------	95.4	67.5	81.5	107	53	2.67	1.10	4.45	5	.0
August-----	94.0	65.5	79.8	108	51	3.04	1.23	4.25	5	.0
September--	84.8	57.2	71.0	102	36	2.51	.75	4.00	4	.0
October----	74.1	45.7	59.9	96	24	1.89	.45	2.64	3	.3
November---	57.4	32.4	44.9	81	6	1.03	.10	1.82	2	1.4
December---	48.2	23.7	36.0	74	-3	.69	.19	1.00	2	3.2
Year-----	70.8	44.0	57.4	109	-10	23.98	19.00	27.80	42	17.2

* Trace.

TABLE 2.--FREEZE DATES IN SPRING AND FALL

Probability	Temperature: 24^{o} F or lower	Temperature: 28^{o} F or lower	Temperature: 32^{o} F or lower
Last freezing temperature in spring:			
1 year in 10 later than--	Apr. 9	Apr. 20	May 3
2 years in 10 later than--	Apr. 4	Apr. 15	Apr. 28
5 years in 10 later than--	Mar. 26	Apr. 5	Apr. 18
First freezing temperature in fall:			
1 year in 10 earlier than--	Oct. 26	Oct. 21	Oct. 12
2 years in 10 earlier than--	Oct. 30	Oct. 26	Oct. 16
5 years in 10 earlier than--	Nov. 9	Nov. 4	Oct. 26

TABLE 3.--GROWING SEASON

Probability	Daily minimum temperature during growing season: Higher than 24^{o} F	Higher than 28^{o} F	Higher than 32^{o} F
	Days	Days	Days
9 years in 10	208	196	173
8 years in 10	215	202	179
5 years in 10	228	213	191
2 years in 10	242	224	203
1 year in 10	249	230	209

TABLE 4.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
Ab	Abilene silt loam, 0 to 1 percent slopes	3,450	0.7
Ac	Abilene silt loam, 1 to 3 percent slopes	17,300	3.4
An	Albion sandy loam, 1 to 4 percent slopes	16,050	3.2
As	Albion-Shellabarger sandy loams, 4 to 15 percent slopes	49,300	9.8
Bt	Buttermilk silt loam	1,182	0.2
Ca	Canadian fine sandy loam	2,600	0.5
Cc	Carey silt loam, 0 to 2 percent slopes	6,700	1.3
Cd	Carey silt loam, 2 to 5 percent slopes	15,800	3.1
Ch	Case clay loam, 1 to 3 percent slopes	2,700	0.5
Ck	Case clay loam, 3 to 7 percent slopes	8,450	1.7
Cm	Case clay loam, 7 to 15 percent slopes	20,500	4.2
Co	Clairemont silt loam, occasionally flooded	3,600	0.7
Cp	Clairemont loam, channeled	4,200	0.8
Cr	Clark clay loam, 0 to 1 percent slopes	4,250	0.8
Cs	Clark clay loam, 1 to 3 percent slopes	26,900	5.4
Ct	Clark clay loam, 3 to 6 percent slopes	8,200	1.6
Cw	Clark-Kingsdown complex, 5 to 12 percent slopes	13,650	2.7
Dc	Dale silt loam	12,500	2.5
Ed	Elandco silt loam, occasionally flooded	750	0.1
Ef	Elandco silt loam, channeled	1,150	0.2
Fe	Farnum loam, 0 to 1 percent slopes	3,600	0.7
Ff	Farnum loam, 1 to 3 percent slopes	8,700	1.7
He	Hedville-Rock outcrop complex, 8 to 30 percent slopes	450	0.1
Hr	Holdrege silt loam, 1 to 3 percent slopes	1,600	0.3
Kc	Kanza loamy fine sand, frequently flooded	3,650	0.7
Kf	Kaski loam	2,450	0.5
Kn	Kingsdown fine sandy loam, 0 to 2 percent slopes	10,650	2.1
Ko	Kingsdown fine sandy loam, 2 to 5 percent slopes	4,400	0.9
Kr	Krier loam	1,300	0.3
Ld	Lancaster-Hedville fine sandy loams, 4 to 12 percent slopes	2,800	0.6
Le	Lesho clay loam, occasionally flooded	900	0.2
Ln	Lincoln loamy sand, occasionally flooded	17,500	3.5
Lo	Lincoln sandy loam, occasionally flooded	2,300	0.5
Lr	Lincoln-Krier complex, occasionally flooded	4,500	0.9
Oa	Obaro silty clay loam, 5 to 12 percent slopes	10,450	2.1
Ob	Obaro-Rock outcrop complex, 10 to 30 percent slopes	6,400	1.3
Oc	Ost clay loam, 2 to 6 percent slopes	1,950	0.4
Ph	Port silt loam, occasionally flooded	2,250	0.4
Po	Pratt loamy fine sand, rolling	1,350	0.3
Pr	Pratt loamy fine sand, undulating	15,400	3.0
Pt	Pratt-Tivoli loamy fine sands, rolling	21,800	4.3
Qr	Quinlan-Woodward loams, 6 to 15 percent slopes	48,800	9.7
Qt	Quinlan-Woodward loams, 15 to 30 percent slopes	18,400	3.6
Sb	St. Paul silt loam, 0 to 1 percent slopes	4,150	0.8
Sc	St. Paul silt loam, 1 to 3 percent slopes	17,600	3.5
Sg	Shellabarger sandy loam, 0 to 1 percent slopes	3,600	0.7
Sh	Shellabarger sandy loam, 1 to 3 percent slopes	16,300	3.2
Sm	Shellabarger sandy loam, 3 to 6 percent slopes	7,250	1.4
Tv	Tivoli fine sand, hilly	3,900	0.8
Wd	Waldeck fine sandy loam, occasionally flooded	7,150	1.4
We	Westview silt loam, 0 to 1 percent slopes	5,400	1.1
Wf	Wellsford clay, 6 to 25 percent slopes	5,850	1.2
Wo	Woodward loam, 1 to 3 percent slopes	4,750	0.9
Ws	Woodward-Quinlan loams, 3 to 6 percent slopes	14,700	2.9
Ye	Yahola fine sandy loam, occasionally flooded	2,100	0.4
Ze	Zenda clay loam, occasionally flooded	1,250	0.2
	Water	250	*
	Total	505,082	100.0

* Less than 0.1 percent.

TABLE 5.--PRIME FARMLAND

(Only the soils considered prime farmland are listed. Urban or built-up areas of the soils listed are not considered prime farmland. If a soil is prime farmland only under certain conditions, the conditions are specified in parentheses after the soil name)

Map symbol	Soil name
Ab	Abilene silt loam, 0 to 1 percent slopes
Ac	Abilene silt loam, 1 to 3 percent slopes
An	Albion sandy loam, 1 to 4 percent slopes (where irrigated)
Ca	Canadian fine sandy loam
Cc	Carey silt loam, 0 to 2 percent slopes
Cd	Carey silt loam, 2 to 5 percent slopes
Ch	Case clay loam, 1 to 3 percent slopes
Ck	Case clay loam, 3 to 7 percent slopes
Co	Clairemont silt loam, occasionally flooded
Cr	Clark clay loam, 0 to 1 percent slopes
Cs	Clark clay loam, 1 to 3 percent slopes
Ct	Clark clay loam, 3 to 6 percent slopes
Dc	Dale silt loam
Ed	Elandco silt loam, occasionally flooded
Fe	Farnum loam, 0 to 1 percent slopes
Ff	Farnum loam, 1 to 3 percent slopes
Hr	Holdrege silt loam, 1 to 3 percent slopes
Kf	Kaski loam
Kn	Kingsdown fine sandy loam, 0 to 2 percent slopes
Ko	Kingsdown fine sandy loam, 2 to 5 percent slopes
Le	Lesho clay loam, occasionally flooded
Oc	Ost clay loam, 2 to 6 percent slopes
Ph	Port silt loam, occasionally flooded
Sb	St. Paul silt loam, 0 to 1 percent slopes
Sc	St. Paul silt loam, 1 to 3 percent slopes
Sg	Shellabarger sandy loam, 0 to 1 percent slopes
Sh	Shellabarger sandy loam, 1 to 3 percent slopes
Sm	Shellabarger sandy loam, 3 to 6 percent slopes
Wd	Waldeck fine sandy loam, occasionally flooded
We	Westview silt loam, 0 to 1 percent slopes
Wo	Woodward loam, 1 to 3 percent slopes
Ye	Yahola fine sandy loam, occasionally flooded
Ze	Zenda clay loam, occasionally flooded

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS

(Yields in the N columns are for nonirrigated soils; those in the I columns are for irrigated soils. Yields are those that can be expected under a high level of management. Absence of a yield indicates that the soil is not suited to the crop or the crop generally is not grown on the soil)

Soil name and map symbol	Land capability		Winter wheat		Grain sorghum		Corn		Soybeans		Alfalfa hay	
	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Tons	Tons
Ab----------------- Abilene	IIc	---	33	---	44	---	---	---	---	---	---	---
Ac----------------- Abilene	IIe	---	30	---	41	---	---	---	---	---	---	---
An----------------- Albion	IIIe	IIIe	26	40	35	90	---	---	---	---	---	5.5
As----------------- Albion-Shellabarger	VIe	---	---	---	---	---	---	---	---	---	---	---
Bt----------------- Buttermilk	IIIs	---	22	---	36	---	---	---	---	---	---	---
Ca----------------- Canadian	IIe	IIe	33	50	45	120	---	135	---	40	---	7.0
Cc----------------- Carey	IIc	---	33	---	41	---	---	---	---	---	---	---
Cd----------------- Carey	IIIe	---	30	---	40	---	---	---	---	---	---	---
Ch----------------- Case	IIIe	---	29	---	38	---	---	---	---	---	---	---
Ck----------------- Case	IVe	---	26	---	34	---	---	---	---	---	---	---
Cm----------------- Case	VIe	---	---	---	---	---	---	---	---	---	---	---
Co----------------- Clairemont	IIw	---	34	---	44	---	---	---	---	---	---	---
Cp----------------- Clairemont	Vw	---	---	---	---	---	---	---	---	---	---	---
Cr----------------- Clark	IIc	I	31	50	41	120	---	140	---	40	---	7.0
Cs----------------- Clark	IIIe	---	30	---	40	---	---	---	---	---	---	---
Ct----------------- Clark	IVe	---	27	---	36	---	---	---	---	---	---	---
Cw----------------- Clark-Kingsdown	VIe	---	---	---	---	---	---	---	---	---	---	---
Dc----------------- Dale	IIc	---	37	---	50	---	---	---	---	---	---	---
Ed----------------- Elandco	IIw	---	36	---	49	---	---	---	---	---	---	---

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Winter wheat		Grain sorghum		Corn		Soybeans		Alfalfa hay	
	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Tons	Tons
Ef---------------- Elandco	Vw	---	---	---	---	---	---	---	---	---	---	---
Fe---------------- Farnum	IIc	---	35	---	47	---	---	---	---	---	---	---
Ff---------------- Farnum	IIe	---	32	---	43	---	---	---	---	---	---	---
He*--------------- Hedville-Rock outcrop	VIIs	---	---	---	---	---	---	---	---	---	---	---
Hr---------------- Holdrege	IIe	---	32	---	40	---	---	---	---	---	---	---
Kc---------------- Kanza	Vw	---	---	---	---	---	---	---	---	---	---	---
Kf---------------- Kaski	IIc	---	37	---	50	---	---	---	---	---	---	---
Kn---------------- Kingsdown	IIe	IIe	28	50	36	110	---	135	---	40	3.5	6.5
Ko---------------- Kingsdown	IIIe	IIIe	25	45	33	110	---	130	---	35	3.0	6.0
Kr---------------- Krier	VIs	---	---	---	---	---	---	---	---	---	---	---
Ld---------------- Lancaster-Hedville	VIe	---	---	---	---	---	---	---	---	---	---	---
Le---------------- Lesho	IIIw	---	26	---	34	---	---	---	---	---	---	---
Ln, Lo------------ Lincoln	VIw	---	---	---	---	---	---	---	---	---	---	---
Lr---------------- Lincoln-Krier	VIw	---	---	---	---	---	---	---	---	---	---	---
Oa---------------- Obaro	VIe	---	---	---	---	---	---	---	---	---	---	---
Ob*--------------- Obaro-Rock outcrop	VIIs	---	---	---	---	---	---	---	---	---	---	---
Oc---------------- Ost	IIIe	---	28	---	37	---	---	---	---	---	---	---
Ph---------------- Port	IIw	---	37	---	49	---	---	---	---	---	---	---
Po---------------- Pratt	IVe	---	21	---	29	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 6.--LAND CAPABILITY CLASSES AND YIELDS PER ACRE OF CROPS--Continued

Soil name and map symbol	Land capability		Winter wheat		Grain sorghum		Corn		Soybeans		Alfalfa hay	
	N	I	N	I	N	I	N	I	N	I	N	I
			Bu	Bu	Bu	Bu	Bu	Bu	Bu	Bu	Tons	Tons
Pr---------------- Pratt	IIIe	IIIe	25	40	34	90	---	115	---	35	---	5.5
Pt---------------- Pratt-Tivoli	VIe	---	---	---	---	---	---	---	---	---	---	---
Qr---------------- Quinlan-Woodward	VIe	---	---	---	---	---	---	---	---	---	---	---
Qt---------------- Quinlan-Woodward	VIIe	---	---	---	---	---	---	---	---	---	---	---
Sb---------------- St. Paul	IIc	---	35	---	47	---	---	---	---	---	---	---
Sc---------------- St. Paul	IIe	---	32	---	44	---	---	---	---	---	---	---
Sg---------------- Shellabarger	IIe	IIe	34	50	46	120	---	125	---	40	---	7.0
Sh---------------- Shellabarger	IIe	IIe	31	45	42	110	---	120	---	35	---	6.5
Sm---------------- Shellabarger	IIIe	---	29	---	39	---	---	---	---	---	---	---
Tv---------------- Tivoli	VIIe	---	---	---	---	---	---	---	---	---	---	---
Wd---------------- Waldeck	IIIw	---	28	---	37	---	---	---	---	---	---	---
We---------------- Westview	IIc	I	38	---	52	100	---	---	---	---	3.0	6.0
Wf---------------- Wellsford	VIe	---	---	---	---	---	---	---	---	---	---	---
Wo---------------- Woodward	IIe	---	25	---	32	---	---	---	---	---	---	---
Ws---------------- Woodward-Quinlan	IVe	---	21	---	27	---	---	---	---	---	---	---
Ye---------------- Yahola	IIw	---	31	---	39	---	---	---	---	---	---	---
Ze---------------- Zenda	IIw	---	32	---	41	---	---	---	---	---	---	---

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--RANGELAND PRODUCTIVITY

Soil name and map symbol	Range site	Potential annual production for kind of growing season: Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
Ab, Ac Abilene	Loamy Upland	3,500	2,500	1,500
An Albion	Sandy	4,000	3,000	2,000
As*:				
Albion	Sandy	4,000	3,000	2,000
Shellabarger	Sandy	4,500	3,200	2,000
Bt Buttermilk	Saline Lowland	4,000	3,000	2,000
Ca Canadian	Sandy Terrace	5,500	4,500	3,000
Cc, Cd Carey	Loamy Upland	3,500	2,500	2,000
Ch, Ck, Cm Case	Limy Upland	3,500	2,500	1,500
Co, Cp Clairemont	Loamy Lowland	6,000	5,000	4,000
Cr, Cs, Ct Clark	Limy Upland	3,500	2,500	1,500
Cw*:				
Clark	Limy Upland	3,500	2,500	1,500
Kingsdown	Sandy	4,500	3,000	2,000
Dc Dale	Loamy Terrace	5,000	4,000	3,000
Ed, Ef Elandco	Loamy Lowland	6,000	5,000	4,000
Fe, Ff Farnum	Loamy Upland	3,500	2,500	2,000
He*:				
Hedville	Shallow Sandstone	3,000	2,000	1,000
Rock outcrop.				
Hr Holdrege	Loamy Upland	3,500	2,500	2,000
Kc Kanza	Subirrigated	9,000	8,000	7,000
Kf Kaski	Loamy Terrace	5,000	4,000	3,000
Kn, Ko Kingsdown	Sandy	4,500	3,000	2,000

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season: Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
Kr: Krier	Saline Subirrigated	6,500	5,500	4,000
Ld*:				
Lancaster	Loamy Upland	3,500	2,500	2,000
Hedville	Shallow Sandstone	3,000	2,000	1,000
Le: Lesho	Subirrigated	9,000	8,000	7,000
Ln, Lo: Lincoln	Sandy Lowland	3,000	2,200	1,800
Lr*:				
Lincoln	Sandy Lowland	3,000	2,200	1,800
Krier	Saline Subirrigated	6,500	5,500	4,000
Oa: Obaro	Loamy Upland	3,000	2,500	2,000
Ob*:				
Obaro	Loamy Upland	3,000	2,500	2,000
Rock outcrop.				
Oc: Ost	Loamy Upland	5,500	4,000	2,500
Ph: Port	Loamy Lowland	6,000	5,000	4,000
Po, Pr: Pratt	Sands	4,500	3,500	2,500
Pt*:				
Pratt	Sands	4,500	3,500	2,500
Tivoli	Sands	4,000	3,000	2,000
Qr*:				
Quinlan	Shallow Prairie	2,500	1,800	1,300
Woodward	Loamy Upland	4,000	2,800	2,000
Qt*:				
Quinlan	Shallow Prairie	2,500	1,800	1,300
Woodward	Loamy Upland	4,000	2,800	2,000
Sb, Sc: St. Paul	Loamy Upland	3,500	2,500	2,000
Sg, Sh, Sm: Shellabarger	Sandy	4,500	3,200	2,000
Tv: Tivoli	Choppy Sands	2,000	1,400	1,000

See footnote at end of table.

TABLE 7.--RANGELAND PRODUCTIVITY--Continued

Soil name and map symbol	Range site	Potential annual production for kind of growing season: Favorable Lb/acre	Average Lb/acre	Unfavorable Lb/acre
Wd: Waldeck	Subirrigated	9,000	8,000	7,000
We: Westview	Loamy Upland	4,000	2,800	2,000
Wf: Wellsford	Blue Shale	3,000	2,000	1,500
Wo: Woodward	Loamy Upland	4,000	2,800	2,000
Ws*:				
Woodward	Loamy Upland	4,000	2,800	2,000
Quinlan	Shallow Prairie	2,500	1,800	1,300
Ye: Yahola	Sandy Lowland	9,000	7,000	5,000
Ze: Zenda	Subirrigated	9,000	8,000	7,000

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS

(The symbol < means less than; > means more than. Absence of an entry indicates that trees generally do not grow to the given height on that soil)

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Ab, Ac------------ Abilene	Lilac, Amur honeysuckle, fragrant sumac.	Russian mulberry	Eastern redcedar, Austrian pine, honeylocust, hackberry, green ash, bur oak, Russian olive.	Siberian elm------	---
An---------------- Albion	Lilac, fragrant sumac, Siberian peashrub.	Russian olive, Rocky Mountain juniper, Russian mulberry.	Eastern redcedar, bur oak, Austrian pine, honeylocust, green ash.	Siberian elm------	---
As*:					
Albion-----------	Lilac, fragrant sumac, Siberian peashrub.	Russian olive, Rocky Mountain juniper, Russian mulberry.	Eastern redcedar, bur oak, Austrian pine, honeylocust, green ash.	Siberian elm------	---
Shellabarger-----	Lilac, American plum, fragrant sumac.	Common chokecherry	Eastern redcedar, ponderosa pine, Austrian pine, honeylocust, Scotch pine, green ash, hackberry.	Siberian elm------	---
Bt---------------- Buttermilk	Amur honeysuckle, silver buffaloberry, lilac, tamarisk.	Eastern redcedar, green ash, Russian olive, Rocky Mountain juniper, Osageorange.	Siberian elm------	---	---
Ca---------------- Canadian	American plum-----	Amur honeysuckle, lilac.	Eastern redcedar, Austrian pine, ponderosa pine, green ash, Russian olive, Russian mulberry.	Honeylocust, hackberry.	Eastern cottonwood.
Cc, Cd------------ Carey	Lilac, Amur honeysuckle, fragrant sumac.	Russian mulberry	Eastern redcedar, Austrian pine, honeylocust, hackberry, green ash, bur oak, Russian olive.	Siberian elm------	---
Ch, Ck, Cm-------- Case	Fragrant sumac, silver buffaloberry, tamarisk.	Eastern redcedar, Rocky Mountain juniper, Russian olive.	Honeylocust, Siberian elm, ponderosa pine, green ash, black locust, Osageorange.	---	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Co, Cp: Clairemont	American plum	Amur honeysuckle, lilac.	Eastern redcedar, ponderosa pine, green ash, Russian olive, Russian mulberry.	Siberian elm, honeylocust, hackberry.	Eastern cottonwood.
Cr, Cs, Ct: Clark	Silver buffaloberry, fragrant sumac, Siberian peashrub, tamarisk.	Eastern redcedar, Rocky Mountain juniper, Russian olive, bur oak.	Green ash, Siberian elm, ponderosa pine, honeylocust.	---	---
Cw*:					
Clark	Silver buffaloberry, fragrant sumac, Siberian peashrub, tamarisk.	Eastern redcedar, Rocky Mountain juniper, Russian olive, bur oak.	Green ash, Siberian elm, ponderosa pine, honeylocust.	---	---
Kingsdown	American plum, common chokecherry, lilac, Amur honeysuckle.	Rocky Mountain juniper, Russian mulberry.	Eastern redcedar, honeylocust, hackberry, ponderosa pine, green ash.	Siberian elm	---
Dc: Dale	American plum	Amur honeysuckle, lilac.	Eastern redcedar, ponderosa pine, Austrian pine, green ash, Russian olive, Russian mulberry.	Honeylocust, hackberry.	Eastern cottonwood.
Ed, Ef: Elandco	American plum	Amur honeysuckle, lilac.	Eastern redcedar, ponderosa pine, Austrian pine, green ash, Russian olive, Russian mulberry.	Honeylocust, hackberry.	Eastern cottonwood.
Fe, Ff: Farnum	Lilac, fragrant sumac, Amur honeysuckle.	Russian mulberry	Eastern redcedar, Austrian pine, hackberry, honeylocust, bur oak, green ash, Russian olive.	Siberian elm	---
He*:					
Hedville.					
Rock outcrop.					

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Hr: Holdrege	Lilac, Amur honeysuckle, fragrant sumac.	Russian mulberry	Eastern redcedar, Austrian pine, green ash, honeylocust, hackberry, bur oak, Russian olive.	Siberian elm	---
Kc: Kanza	American plum, redosier dogwood.	Common chokecherry	Russian mulberry, eastern redcedar, Austrian pine, hackberry, green ash.	Honeylocust, silver maple, golden willow.	Eastern cottonwood.
Kf: Kaski	American plum	Lilac, Amur honeysuckle.	Eastern redcedar, Austrian pine, green ash, Russian mulberry, ponderosa pine, Russian olive.	Hackberry, honeylocust.	Eastern cottonwood.
Kn, Ko: Kingsdown	American plum, common chokecherry, lilac, Amur honeysuckle.	Rocky Mountain juniper, Russian mulberry.	Eastern redcedar, honeylocust, hackberry, ponderosa pine, green ash.	Siberian elm	---
Kr: Krier	Silver buffaloberry, lilac, tamarisk.	Eastern redcedar, Rocky Mountain juniper, green ash, Russian olive, Siberian peashrub.	Golden willow, Siberian elm.	---	Eastern cottonwood.
Ld*:					
Lancaster	Fragrant sumac, lilac, Siberian peashrub.	Rocky Mountain juniper, Russian mulberry, Russian olive.	Eastern redcedar, green ash, Austrian pine, bur oak, honeylocust.	Siberian elm	---
Hedville.					
Le: Lesho	American plum, lilac.	Amur honeysuckle	Russian olive, Rocky Mountain juniper, eastern redcedar, ponderosa pine, green ash, hackberry.	Honeylocust, Siberian elm.	Eastern cottonwood.
Ln, Lo: Lincoln	Common chokecherry, Amur honeysuckle, lilac, American plum.	Rocky Mountain juniper, Russian mulberry.	Eastern redcedar, ponderosa pine, honeylocust, hackberry, green ash.	Siberian elm	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Lr*:					
Lincoln	Common chokecherry, Amur honeysuckle, lilac, American plum.	Rocky Mountain juniper, Russian mulberry.	Eastern redcedar, ponderosa pine, honeylocust, hackberry, green ash.	Siberian elm	---
Krier	Silver buffaloberry, lilac, tamarisk.	Eastern redcedar, Rocky Mountain juniper, green ash, Russian olive, Siberian peashrub.	Golden willow, Siberian elm.	---	Eastern cottonwood.
Oa Obaro	---	Oriental arborvitae, Rocky Mountain juniper, Russian olive, eastern redcedar, Osageorange.	Siberian elm	---	---
Ob*:					
Obaro	---	Oriental arborvitae, Rocky Mountain juniper, Russian olive, eastern redcedar, Osageorange.	Siberian elm	---	---
Rock outcrop.					
Oc Ost	Siberian peashrub, fragrant sumac, silver buffaloberry, Tatarian honeysuckle.	Eastern redcedar, Russian olive, Rocky Mountain juniper, bur oak.	Ponderosa pine, Siberian elm, honeylocust, green ash.	---	---
Ph Port	Skunkbush sumac	Amur honeysuckle, American plum, lilac.	Austrian pine, eastern redcedar, Siberian elm, Russian mulberry, oriental arborvitae.	Green ash	American sycamore, eastern cottonwood.
Po, Pr Pratt	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine.	---	---
Pt*:					
Pratt	---	Eastern redcedar, Rocky Mountain juniper.	Ponderosa pine, Austrian pine.	---	---
Tivoli	---	Rocky Mountain juniper.	Eastern redcedar, oriental arborvitae, ponderosa pine, Austrian pine.	---	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of--				
	<8	8-15	16-25	26-35	>35
Qr*, Qt*: Quinlan.					
Woodward	Fragrant sumac, Siberian peashrub, tamarisk.	Russian olive, Russian mulberry.	Rocky Mountain juniper, bur oak, green ash, eastern redcedar, honeylocust, Austrian pine.	Siberian elm	---
Sb, Sc St. Paul	Fragrant sumac	American plum	Austrian pine, eastern redcedar, ponderosa pine, red mulberry, oriental arborvitae, hackberry.	Black locust, Chinese elm, green ash.	Eastern cottonwood.
Sg, Sh, Sm Shellabarger	Lilac, American plum, fragrant sumac.	Common chokecherry	Eastern redcedar, ponderosa pine, Austrian pine, honeylocust, Scotch pine, green ash, hackberry.	Siberian elm	---
Tv Tivoli	---	Rocky Mountain juniper.	Eastern redcedar, oriental arborvitae, ponderosa pine, Austrian pine.	---	---
Wd Waldeck	Fragrant sumac	Siberian peashrub, silver buffaloberry.	Eastern redcedar, Russian mulberry, ponderosa pine, green ash, Russian olive.	Hackberry, Siberian elm, honeylocust.	Eastern cottonwood.
We Westview	Skunkbush sumac	American plum, Amur honeysuckle, lilac.	---	Austrian pine, ponderosa pine, honeylocust, red mulberry, Chinese elm, eastern redcedar, black locust.	Eastern cottonwood.
Wf. Wellsford					
Wo Woodward	Fragrant sumac, Siberian peashrub, tamarisk.	Russian olive, Russian mulberry.	Rocky Mountain juniper, bur oak, green ash, eastern redcedar, honeylocust.	Siberian elm	---

See footnote at end of table.

TABLE 8.--WINDBREAKS AND ENVIRONMENTAL PLANTINGS--Continued

Soil name and map symbol	Trees having predicted 20-year average height, in feet, of-- <8	8-15	16-25	26-35	>35
Ws*:					
Woodward	Fragrant sumac, Siberian peashrub, tamarisk.	Russian olive, Russian mulberry.	Rocky Mountain juniper, bur oak, green ash, eastern redcedar, honeylocust, ponderosa pine.	Siberian elm	---
Quinlan.					
Ye Yahola	Fragrant sumac	American plum, lilac.	Red mulberry, Osageorange, eastern redcedar, ponderosa pine, Siberian elm, oriental arborvitae.	Green ash	Eastern cottonwood, American sycamore.
Ze Zenda	Fragrant sumac	Silver buffaloberry, Siberian peashrub.	Eastern redcedar, green ash, ponderosa pine, Russian olive, Russian mulberry.	Hackberry, Siberian elm, honeylocust.	Eastern cottonwood.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--RECREATIONAL DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ab: Abilene	Slight	Slight	Slight	Slight.
Ac: Abilene	Slight	Slight	Moderate: slope.	Slight.
An: Albion	Slight	Slight	Moderate: slope, small stones.	Slight.
As*:				
Albion	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Shellabarger	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Bt: Buttermilk	Severe: flooding.	Moderate: excess salt.	Moderate: excess salt.	Slight.
Ca: Canadian	Severe: flooding.	Slight	Slight	Slight.
Cc: Carey	Slight	Slight	Slight	Slight.
Cd: Carey	Slight	Slight	Moderate: slope.	Slight.
Ch, Ck: Case	Slight	Slight	Moderate: slope.	Slight.
Cm: Case	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Co: Clairemont	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Cp: Clairemont	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Cr: Clark	Slight	Slight	Slight	Slight.
Cs, Ct: Clark	Slight	Slight	Moderate: slope.	Slight.
Cw*:				
Clark	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Kingsdown	Slight	Slight	Moderate: slope.	Slight.
Dc: Dale	Severe: flooding.	Slight	Slight	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Ed: Elandco	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Ef: Elandco	Severe: flooding.	Moderate: flooding.	Severe: flooding.	Moderate: flooding.
Fe: Farnum	Slight	Slight	Slight	Slight.
Ff: Farnum	Slight	Slight	Moderate: slope.	Slight.
He*:				
Hedville	Severe: slope, thin layer, area reclaim.	Severe: slope, thin layer, area reclaim.	Severe: slope, small stones.	Moderate: slope.
Rock outcrop.				
Hr: Holdrege	Slight	Slight	Moderate: slope.	Slight.
Kc: Kanza	Severe: flooding, wetness.	Severe: wetness.	Severe: wetness, flooding.	Severe: wetness.
Kf: Kaski	Severe: flooding.	Slight	Slight	Slight.
Kn: Kingsdown	Slight	Slight	Slight	Slight.
Ko: Kingsdown	Slight	Slight	Moderate: slope.	Slight.
Kr: Krier	Severe: flooding, wetness.	Moderate: wetness, excess salt.	Severe: wetness.	Moderate: wetness.
Ld*:				
Lancaster	Slight	Slight	Severe: slope.	Slight.
Hedville	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: slope, small stones.	Slight.
Le: Lesho	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Slight.
Ln, Lo: Lincoln	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Lr*:				
Lincoln	Severe: flooding.	Slight	Moderate: flooding.	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Lr*:				
Krier	Severe: flooding, wetness.	Moderate: wetness, excess salt.	Severe: wetness.	Moderate: wetness.
Oa Obaro	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Ob*:				
Obaro	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Rock outcrop.				
Oc Ost	Slight	Slight	Moderate: slope.	Slight.
Ph Port	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Po Pratt	Slight	Slight	Severe: slope.	Slight.
Pr Pratt	Slight	Slight	Moderate: slope.	Slight.
Pt*:				
Pratt	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Tivoli	Moderate: slope.	Moderate: slope.	Severe: slope.	Slight.
Qr*:				
Quinlan	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: slope, thin layer.	Severe: erodes easily.
Woodward	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: erodes easily.
Qt*:				
Quinlan	Severe: slope, thin layer.	Severe: slope, thin layer.	Severe: slope, thin layer.	Severe: erodes easily.
Woodward	Severe: slope.	Severe: slope.	Severe: slope.	Severe: erodes easily.
Sb St. Paul	Slight	Slight	Slight	Slight.
Sc St. Paul	Slight	Slight	Moderate: slope.	Slight.
Sg Shellabarger	Slight	Slight	Slight	Slight.
Sh, Sm Shellabarger	Slight	Slight	Moderate: slope.	Slight.

See footnote at end of table.

TABLE 9.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
Tv: Tivoli	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: slope, too sandy.	Severe: too sandy.
Wd: Waldeck	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Slight.
We: Westview	Slight	Slight	Slight	Severe: erodes easily.
Wf: Wellsford	Severe: slope, percs slowly, too clayey.	Severe: slope, too clayey, percs slowly.	Severe: slope, too clayey, thin layer.	Severe: too clayey.
Wo: Woodward	Slight	Slight	Moderate: slope, thin layer, area reclaim.	Slight.
Ws*:				
Woodward	Slight	Slight	Moderate: slope, thin layer, area reclaim.	Slight.
Quinlan	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Severe: thin layer, area reclaim.	Slight.
Ye: Yahola	Severe: flooding.	Slight	Moderate: flooding.	Slight.
Ze: Zenda	Severe: flooding.	Moderate: wetness.	Moderate: wetness, flooding.	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--WILDLIFE HABITAT

(See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated)

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
Ab, Ac: Abilene	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
An: Albion	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
As*:									
Albion	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Shellabarger	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
Bt: Buttermilk	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Ca: Canadian	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Cc: Carey	Good	Good	Fair	Fair	Very poor	Very poor	Good	Very poor	Fair.
Cd: Carey	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Ch, Ck: Case	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Cm: Case	Poor	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Co: Clairemont	Good	Good	Fair	Good	Very poor	Very poor	Good	Very poor	Fair.
Cp: Clairemont	Very poor	Poor	Fair	Good	Very poor	Very poor	Poor	Very poor	Fair.
Cr: Clark	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
Cs: Clark	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Ct: Clark	Fair	Good	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Cw*:									
Clark	Poor	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
Kingsdown	Poor	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Dc: Dale	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.
Ed: Elandco	Good	Good	Fair	Good	Poor	Very poor	Good	Very poor	Fair.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
Ef----------------- Elandco	Very poor	Poor	Fair	Good	Poor	Very poor	Poor	Very poor	Fair.
Fe, Ff------------- Farnum	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
He*:									
Hedville----------	Very poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Rock outcrop.									
Hr----------------- Holdrege	Good	Good	Fair	Fair	Very poor	Very poor	Good	Very poor	Fair.
Kc----------------- Kanza	Very poor	Poor	Fair	Fair	Fair	Fair	Poor	Fair	Fair.
Kf----------------- Kaski	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Kn, Ko------------- Kingsdown	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Kr----------------- Krier	Poor	Poor	Fair	Poor	Good	Good	Poor	Good	Poor.
Ld*:									
Lancaster---------	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Hedville----------	Very poor	Poor	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Le----------------- Lesho	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair.
Ln, Lo------------- Lincoln	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Lr*:									
Lincoln-----------	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Krier-------------	Poor	Poor	Fair	Poor	Good	Good	Poor	Good	Poor.
Oa----------------- Obaro	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Ob*:									
Obaro-------------	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Rock outcrop.									
Oc----------------- Ost	Fair	Good	Fair	Fair	Poor	Poor	Fair	Poor	Fair.
Ph----------------- Port	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Po, Pr------------- Pratt	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.

See footnote at end of table.

TABLE 10.--WILDLIFE HABITAT--Continued

Soil name and map symbol	Potential for habitat elements: Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Potential as habitat for--: Openland wildlife	Wetland wildlife	Rangeland wildlife
Pt*:									
Pratt	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Tivoli	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Qr*:									
Quinlan	Poor	Poor	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
Woodward	Fair	Good	Good	Fair	Very poor	Very poor	Good	Very poor	Fair.
Qt*:									
Quinlan	Poor	Poor	Fair	Poor	Very poor	Very poor	Fair	Very poor	Poor.
Woodward	Poor	Fair	Good	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Sb, Sc St. Paul	Good	Good	Fair	Fair	Poor	Very poor	Good	Very poor	Fair.
Sg, Sh Shellabarger	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Sm Shellabarger	Fair	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Tv Tivoli	Poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
Wd Waldeck	Fair	Good	Good	Good	Fair	Fair	Good	Fair	Good.
We Westview	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Wf Wellsford	Very poor	Very poor	Good	---	Very poor	Very poor	Very poor	Very poor	Good.
Wo Woodward	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Ws*:									
Woodward	Fair	Good	Good	Fair	Poor	Very poor	Good	Very poor	Fair.
Quinlan	Poor	Poor	Fair	Poor	Poor	Very poor	Fair	Very poor	Poor.
Ye Yahola	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
Ze Zenda	Fair	Good	Good	Good	Fair	Fair	Good	Fair	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--BUILDING SITE DEVELOPMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ab, Ac: Abilene	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
An: Albion	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
As*:					
Albion	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Shellabarger	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Bt: Buttermilk	Moderate: wetness.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength.
Ca: Canadian	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Cc, Cd: Carey	Slight	Slight	Slight	Slight	Severe: low strength.
Ch: Case	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Ck: Case	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Cm: Case	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Co, Cp: Clairemont	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Cr, Cs: Clark	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Ct: Clark	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Severe: low strength.
Cw*:					
Clark	Moderate: slope.	Moderate: shrink-swell, slope.	Moderate: slope, shrink-swell.	Severe: slope.	Severe: low strength.
Kingsdown	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Dc: Dale	Slight	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: shrink-swell, flooding.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ed, Ef------------ Elandco	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: low strength, flooding.
Fe, Ff------------ Farnum	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
He*:					
Hedville---------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
Rock outcrop.					
Hr---------------- Holdrege	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Kc---------------- Kanza	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: wetness, flooding.
Kf---------------- Kaski	Slight-----------	Severe: flooding.	Severe: flooding.	Severe: flooding.	Moderate: flooding.
Kn, Ko------------ Kingsdown	Severe: cutbanks cave.	Slight-----------	Slight-----------	Slight------------	Slight.
Kr---------------- Krier	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.
Ld*:					
Lancaster--------	Slight-----------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, slope.	Moderate: shrink-swell, low strength.
Hedville---------	Severe: depth to rock.	Severe: depth to rock.	Severe: depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.
Le---------------- Lesho	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding.
Ln, Lo------------ Lincoln	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Lr*:					
Lincoln----------	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Krier------------	Severe: cutbanks cave, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding.
Oa---------------- Obaro	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
Ob*:					
Obaro	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Severe: low strength.
Rock outcrop.					
Oc Ost	Slight	Slight	Slight	Moderate: slope.	Slight.
Ph Port	Moderate: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Po Pratt	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Pr Pratt	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Pt*:					
Pratt	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Tivoli	Severe: cutbanks cave.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Qr*:					
Quinlan	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Woodward	Moderate: slope.	Moderate: slope.	Moderate: slope.	Severe: slope.	Moderate: slope.
Qt*:					
Quinlan	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Woodward	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Sb, Sc St. Paul	Slight	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Sg, Sh Shellabarger	Severe: cutbanks cave.	Slight	Slight	Slight	Slight.
Sm Shellabarger	Severe: cutbanks cave.	Slight	Slight	Moderate: slope.	Slight.
Tv Tivoli	Severe: cutbanks cave, slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Wd Waldeck	Severe: cutbanks cave, wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: flooding.

See footnote at end of table.

TABLE 11.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
We------ Westview	Slight------	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Severe: low strength.
Wf------ Wellsford	Severe: slope.	Severe: shrink-swell, slope.	Severe: slope, shrink-swell.	Severe: shrink-swell, slope.	Severe: shrink-swell, low strength, slope.
Wo------ Woodward	Slight------	Slight------	Slight------	Slight------	Slight.
Ws*:					
Woodward------	Slight------	Slight------	Slight------	Moderate: slope.	Slight.
Quinlan------	Slight------	Slight------	Slight------	Moderate: slope.	Slight.
Ye------ Yahola	Severe: cutbanks cave.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.
Ze------ Zenda	Severe: wetness.	Severe: flooding.	Severe: flooding, wetness.	Severe: flooding.	Severe: low strength, flooding.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 12.--SANITARY FACILITIES

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "good," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ab: Abilene	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
Ac: Abilene	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey, hard to pack.
An: Albion	Severe: poor filter.	Severe: seepage.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
As*:					
Albion	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy, small stones.
Shellabarger	Moderate: slope.	Severe: slope.	Moderate: slope.	Moderate: slope.	Poor: thin layer.
Bt: Buttermilk	Moderate: flooding, wetness, percs slowly.	Moderate: seepage, wetness.	Severe: wetness.	Moderate: flooding, wetness.	Fair: too clayey.
Ca: Canadian	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Good.
Cc: Carey	Slight	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: area reclaim, too clayey.
Cd: Carey	Slight	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: area reclaim, too clayey.
Ch, Ck: Case	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Cm: Case	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Co, Cp: Clairemont	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Cr: Clark	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Cs, Ct: Clark	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Cw*:					
Clark	Moderate: percs slowly, slope.	Severe: slope.	Moderate: slope, too clayey.	Moderate: slope.	Fair: too clayey, slope.
Kingsdown	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Dc Dale	Moderate: flooding, percs slowly.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Ed, Ef Elandco	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Good.
Fe Farnum	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Ff Farnum	Moderate: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
He*:					
Hedville	Severe: thin layer, seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage, slope.	Severe: seepage, slope.	Poor: area reclaim, slope, thin layer.
Rock outcrop.					
Hr Holdrege	Slight	Moderate: seepage, slope.	Slight	Slight	Good.
Kc Kanza	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
Kf Kaski	Moderate: flooding.	Moderate: seepage.	Moderate: flooding.	Moderate: flooding.	Good.
Kn, Ko Kingsdown	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
Kr Krier	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
Ld*:					
Lancaster	Severe: thin layer, seepage.	Severe: seepage, slope.	Severe: seepage.	Moderate: seepage.	Poor: area reclaim, thin layer.
Hedville	Severe: thin layer, seepage.	Severe: depth to rock, seepage, slope.	Severe: depth to rock, seepage.	Severe: seepage.	Poor: area reclaim, thin layer.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Le------------------ Lesho	Severe: flooding, wetness, percs slowly.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy.
Ln, Lo-------------- Lincoln	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Poor: seepage, too sandy.
Lr*:					
Lincoln------------	Severe: flooding, poor filter.	Severe: seepage, flooding.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage.	Poor: seepage, too sandy.
Krier--------------	Severe: flooding, wetness, poor filter.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Poor: seepage, too sandy, wetness.
Oa------------------ Obaro	Severe: thin layer, seepage.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: area reclaim.
Ob*:					
Obaro--------------	Severe: thin layer, seepage.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: area reclaim.
Rock outcrop.					
Oc------------------ Ost	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight-----------	Fair: too clayey.
Ph------------------ Port	Severe: flooding.	Severe: flooding.	Severe: flooding.	Severe: flooding.	Fair: too clayey.
Po------------------ Pratt	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
Pr------------------ Pratt	Severe: poor filter.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
Pt*:					
Pratt--------------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: thin layer.
Tivoli-------------	Severe: poor filter.	Severe: seepage, slope.	Severe: seepage, too sandy.	Severe: seepage.	Poor: seepage, too sandy.
Qr*:					
Quinlan------------	Severe: thin layer, seepage.	Severe: seepage, slope.	Severe: seepage.	Severe: seepage.	Poor: area reclaim.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Qr*:					
Woodward	Severe: thin layer, seepage.	Severe: slope, seepage.	Severe: seepage.	Severe: seepage.	Poor: area reclaim.
Qt*:					
Quinlan	Severe: thin layer, seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope.	Poor: area reclaim, slope.
Woodward	Severe: thin layer, seepage, slope.	Severe: slope, seepage.	Severe: seepage, slope.	Severe: slope, seepage.	Poor: area reclaim, slope.
Sb St. Paul	Severe: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.
Sc St. Paul	Severe: percs slowly.	Moderate: seepage, slope.	Moderate: too clayey.	Slight	Fair: too clayey.
Sg Shellabarger	Slight	Moderate: seepage.	Slight	Slight	Poor: thin layer.
Sh, Sm Shellabarger	Slight	Moderate: seepage, slope.	Slight	Slight	Poor: thin layer.
Tv Tivoli	Severe: poor filter, slope.	Severe: seepage, slope.	Severe: seepage, slope, too sandy.	Severe: seepage, slope.	Poor: seepage, too sandy, slope.
Wd Waldeck	Severe: flooding, wetness.	Severe: seepage, flooding, wetness.	Severe: flooding, seepage, wetness.	Severe: flooding, seepage, wetness.	Fair: wetness, thin layer.
We Westview	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
Wf Wellsford	Severe: thin layer, seepage, slope.	Severe: seepage, slope.	Severe: seepage, slope, too clayey.	Severe: seepage, slope.	Poor: area reclaim, too clayey, hard to pack.
Wo Woodward	Severe: thin layer, seepage.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: area reclaim.
Ws*:					
Woodward	Severe: thin layer, seepage.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: area reclaim.
Quinlan	Severe: thin layer, seepage.	Severe: seepage.	Severe: seepage.	Severe: seepage.	Poor: area reclaim.

See footnote at end of table.

TABLE 12.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
Ye------------------ Yahola	Severe: flooding.	Severe: seepage, flooding.	Severe: flooding, seepage.	Severe: flooding, seepage.	Good.
Ze------------------ Zenda	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Severe: flooding, wetness.	Fair: too clayey, wetness.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 13.--CONSTRUCTION MATERIALS

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "good," "fair," and other terms. Absence of an entry indicates that the soil was not rated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ab, Ac: Abilene	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: too clayey.
An: Albion	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
As*:				
Albion	Good	Probable	Probable	Poor: too sandy, small stones, area reclaim.
Shellabarger	Good	Probable	Improbable: too sandy.	Fair: small stones, area reclaim.
Bt: Buttermilk	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: excess salt.
Ca: Canadian	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
Cc, Cd: Carey	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ch, Ck: Case	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Cm: Case	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones, slope.
Co, Cp: Clairemont	Fair: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Cr, Cs, Ct: Clark	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Cw*:				
Clark	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, slope.
Kingsdown	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
Dc: Dale	Fair: shrink-swell.	Improbable: excess fines.	Improbable: excess fines.	Good.
Ed, Ef: Elandco	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Fe, Ff: Farnum	Good	Improbable: excess fines.	Improbable: excess fines.	Good.
He*:				
Hedville	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
Rock outcrop.				
Hr: Holdrege	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Kc: Kanza	Poor: wetness.	Probable	Improbable: too sandy.	Poor: wetness.
Kf: Kaski	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Kn, Ko: Kingsdown	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too sandy.
Kr: Krier	Fair: wetness.	Probable	Improbable: too sandy.	Poor: thin layer.
Ld*:				
Lancaster	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, small stones, thin layer.
Hedville	Poor: area reclaim, thin layer.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, small stones, thin layer.
Le: Lesho	Fair: wetness.	Probable	Improbable: too sandy.	Fair: too clayey, thin layer.
Ln, Lo: Lincoln	Good	Probable	Improbable: too sandy.	Fair: too sandy.
Lr*:				
Lincoln	Good	Probable	Improbable: too sandy.	Fair: too sandy.
Krier	Fair: wetness.	Probable	Improbable: too sandy.	Poor: thin layer.
Oa: Obaro	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, thin layer.
Ob*:				
Obaro	Poor: area reclaim, low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim, too clayey, thin layer.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Ob*: Rock outcrop.				
Oc: Ost	Good	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey, small stones.
Ph: Port	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Po, Pr: Pratt	Good	Probable	Improbable: too sandy.	Fair: too sandy.
Pt*: Pratt	Good	Probable	Improbable: too sandy.	Fair: too sandy.
Tivoli	Good	Probable	Improbable: too sandy.	Poor: too sandy.
Qr*: Quinlan	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Woodward	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: slope, area reclaim.
Qt*: Quinlan	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, slope.
Woodward	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: slope.
Sb, Sc: St. Paul	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Good.
Sg, Sh, Sm: Shellabarger	Good	Probable	Improbable: too sandy.	Fair: small stones, area reclaim.
Tv: Tivoli	Fair: slope.	Probable	Improbable: too sandy.	Poor: too sandy, slope.
Wd: Waldeck	Fair: wetness.	Probable	Improbable: too sandy.	Good.
We: Westview	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.
Wf: Wellsford	Poor: area reclaim, shrink-swell, low strength.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim, too clayey, slope.

See footnote at end of table.

TABLE 13.--CONSTRUCTION MATERIALS--Continued

Soil name and map symbol	Roadfill	Sand	Gravel	Topsoil
Wo------------------- Woodward	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
Ws*:				
Woodward-------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Fair: area reclaim.
Quinlan--------------	Poor: area reclaim.	Improbable: excess fines.	Improbable: excess fines.	Poor: area reclaim.
Ye------------------- Yahola	Good-----------------	Improbable: excess fines.	Improbable: excess fines.	Good.
Ze------------------- Zenda	Poor: low strength.	Improbable: excess fines.	Improbable: excess fines.	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 14.--WATER MANAGEMENT

(Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not evaluated. The information in this table indicates the dominant soil condition but does not eliminate the need for onsite investigation)

Soil name and map symbol	Limitations for-- Pond reservoir areas	Limitations for-- Embankments, dikes, and levees	Features affecting-- Drainage	Features affecting-- Irrigation	Features affecting-- Terraces and diversions	Features affecting-- Grassed waterways
Ab, Ac: Abilene	Slight	Moderate: hard to pack.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
An: Albion	Severe: seepage.	Severe: seepage.	Deep to water	Droughty, soil blowing.	Too sandy, soil blowing.	Droughty.
As*:						
Albion	Severe: seepage, slope.	Severe: seepage.	Deep to water	Slope, droughty, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Shellabarger	Severe: slope.	Severe: thin layer.	Deep to water	Slope, soil blowing.	Slope, soil blowing.	Slope.
Bt: Buttermilk	Moderate: seepage.	Moderate: piping, excess salt.	Deep to water	Excess salt	Erodes easily	Excess salt, erodes easily.
Ca: Canadian	Severe: seepage.	Severe: piping.	Deep to water	Soil blowing	Soil blowing	Favorable.
Cc: Carey	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
Cd: Carey	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily.	Erodes easily	Erodes easily.
Ch: Case	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
Ck: Case	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Favorable	Favorable.
Cm: Case	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope	Slope.
Co, Cp: Clairemont	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily	Erodes easily.
Cr, Cs: Clark	Moderate: seepage.	Moderate: piping.	Deep to water	Favorable	Favorable	Favorable.
Ct: Clark	Moderate: seepage, slope.	Moderate: piping.	Deep to water	Slope	Favorable	Favorable.
Cw*:						
Clark	Severe: slope.	Moderate: piping.	Deep to water	Slope	Slope	Slope.
Kingsdown	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing, slope.	Soil blowing	Favorable.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Dc---------------- Dale	Moderate: seepage.	Moderate: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
Ed, Ef------------ Elandco	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, flooding.	Erodes easily	Erodes easily.
Fe, Ff------------ Farnum	Moderate: seepage.	Severe: thin layer.	Deep to water	Favorable------	Favorable------	Favorable.
He*:						
Hedville---------	Severe: depth to rock, seepage, slope.	Severe: piping, thin layer.	Deep to water	Slope, soil blowing, thin layer.	Slope, area reclaim, soil blowing.	Slope, depth to rock, area reclaim.
Rock outcrop.						
Hr---------------- Holdrege	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Erodes easily	Erodes easily.
Kc---------------- Kanza	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave.	Wetness, droughty, fast intake.	Wetness, too sandy, soil blowing.	Wetness, droughty.
Kf---------------- Kaski	Moderate: seepage.	Severe: piping.	Deep to water	Favorable------	Favorable------	Favorable.
Kn---------------- Kingsdown	Severe: seepage.	Severe: seepage, piping.	Deep to water	Soil blowing---	Soil blowing---	Favorable.
Ko---------------- Kingsdown	Severe: seepage.	Severe: seepage, piping.	Deep to water	Slope, soil blowing.	Soil blowing---	Favorable.
Kr---------------- Krier	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave, excess salt.	Wetness, droughty.	Wetness, too sandy.	Wetness, excess salt, droughty.
Ld*:						
Lancaster--------	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Soil blowing, thin layer, slope.	Area reclaim, soil blowing.	Area reclaim.
Hedville---------	Severe: depth to rock, seepage, slope.	Severe: piping, thin layer.	Deep to water	Slope, soil blowing, thin layer.	Slope, area reclaim, soil blowing.	Slope, depth to rock, area reclaim.
Le---------------- Lesho	Severe: seepage.	Severe: seepage, piping.	Flooding, cutbanks cave.	Wetness, flooding.	Wetness, too sandy.	Favorable.
Ln---------------- Lincoln	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Lo-----------------Lincoln	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, soil blowing, flooding.	Too sandy, soil blowing.	Droughty.
Lr*:						
Lincoln-----------	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Krier-------------	Severe: seepage.	Severe: seepage, piping, wetness.	Flooding, cutbanks cave, excess salt.	Wetness, droughty.	Wetness, too sandy.	Wetness, excess salt, droughty.
Oa-----------------Obaro	Severe: slope.	Severe: piping.	Deep to water	Thin layer, slope, erodes easily.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
Ob*:						
Obaro-------------	Severe: slope.	Severe: piping.	Deep to water	Thin layer, slope, erodes easily.	Slope, area reclaim, erodes easily.	Slope, erodes easily, area reclaim.
Rock outcrop.						
Oc-----------------Ost	Moderate: slope.	Severe: piping.	Deep to water	Slope-----------	Favorable-------	Favorable.
Ph-----------------Port	Moderate: seepage.	Moderate: piping.	Deep to water	Flooding--------	Favorable-------	Favorable.
Po, Pr-------------Pratt	Severe: seepage.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Too sandy, soil blowing.	Droughty.
Pt*:						
Pratt-------------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Tivoli------------	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Qr*, Qt*:						
Quinlan-----------	Severe: seepage, slope.	Severe: piping, thin layer.	Deep to water	Thin layer, slope.	Slope, area reclaim.	Slope, area reclaim.
Woodward----------	Severe: slope.	Severe: piping.	Deep to water	Slope, erodes easily, area reclaim.	Area reclaim, erodes easily, slope.	Slope, area reclaim, erodes easily.
Sb, Sc-------------St. Paul	Moderate: seepage.	Moderate: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
Sg, Sh-------------Shellabarger	Moderate: seepage.	Severe: thin layer.	Deep to water	Soil blowing----	Soil blowing----	Favorable.

See footnote at end of table.

TABLE 14.--WATER MANAGEMENT--Continued

Soil name and map symbol	Limitations for-- Pond reservoir areas	Embankments, dikes, and levees	Features affecting-- Drainage	Irrigation	Terraces and diversions	Grassed waterways
Sm: Shellabarger	Moderate: seepage, slope.	Severe: thin layer.	Deep to water	Slope, soil blowing.	Soil blowing	Favorable.
Tv: Tivoli	Severe: seepage, slope.	Severe: seepage, piping.	Deep to water	Droughty, fast intake, soil blowing.	Slope, too sandy, soil blowing.	Slope, droughty.
Wd: Waldeck	Severe: seepage.	Severe: piping.	Flooding	Wetness, soil blowing, flooding.	Wetness, soil blowing.	Favorable.
We: Westview	Slight	Moderate: piping.	Deep to water	Erodes easily	Erodes easily	Erodes easily.
Wf: Wellsford	Severe: seepage, slope.	Severe: thin layer.	Deep to water	Slope, slow intake, percs slowly.	Slope, area reclaim, percs slowly.	Slope, area reclaim, percs slowly.
Wo: Woodward	Moderate: seepage.	Severe: piping.	Deep to water	Erodes easily, thin layer.	Area reclaim, erodes easily.	Area reclaim, erodes easily.
Ws*:						
Woodward	Moderate: seepage, slope.	Severe: piping.	Deep to water	Slope, erodes easily, thin layer.	Area reclaim, erodes easily.	Area reclaim, erodes easily.
Quinlan	Severe: seepage.	Severe: piping, thin layer.	Deep to water	Thin layer, slope.	Area reclaim	Area reclaim.
Ye: Yahola	Severe: seepage.	Severe: piping.	Deep to water	Flooding, soil blowing.	Soil blowing	Favorable.
Ze: Zenda	Moderate: seepage.	Moderate: piping, wetness.	Flooding	Wetness, flooding.	Wetness	Favorable.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 15.--ENGINEERING INDEX PROPERTIES

(The symbol < means less than; > means more than. Absence of an entry indicates that data were not estimated)

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ab, Ac Abilene	0-8	Silt loam	CL	A-4, A-6	0	98-100	96-100	90-100	60-96	25-35	8-16
	8-35	Clay loam, silty clay loam, silty clay.	CL, CH	A-7, A-6	0	98-100	96-100	90-100	75-95	34-58	22-40
	35-60	Clay loam, clay, silty clay loam.	CL	A-6, A-7	0	90-100	88-100	80-98	60-95	35-50	19-32
An Albion	0-8	Sandy loam	SM, ML	A-2, A-4	0	100	75-100	60-90	25-55	<30	NP-5
	8-16	Sandy loam, loam	SM, ML	A-2, A-4	0	85-100	75-100	45-90	30-55	20-35	NP-10
	16-28	Coarse sandy loam, loamy sand.	SM	A-2, A-1	0	85-100	75-90	40-70	15-30	<30	NP-5
	28-60	Loamy sand, gravelly sand, sand.	SP-SM, GP-GM, SM, GM	A-2, A-1, A-3	0-5	40-100	40-90	30-70	5-30	<30	NP-5
As*: Albion	0-8	Sandy loam	SM, ML	A-2, A-4	0	100	75-100	60-90	25-55	<30	NP-5
	8-16	Sandy loam, loam	SM, ML	A-2, A-4	0	85-100	75-100	45-90	30-55	20-35	NP-10
	16-28	Coarse sandy loam, loamy sand.	SM	A-2, A-1	0	85-100	75-90	40-70	15-30	<30	NP-5
	28-60	Loamy sand, gravelly sand, sand.	SP-SM, GP-GM, SM, GM	A-2, A-1, A-3	0-5	40-100	40-90	30-70	5-30	<30	NP-5
Shellabarger	0-11	Sandy loam	SM, ML	A-4, A-2	0	95-100	95-100	75-100	30-55	<30	NP-5
	11-38	Sandy clay loam, sandy loam, fine sandy loam.	SC	A-4, A-6	0	95-100	85-100	70-90	35-50	25-40	8-20
	38-60	Coarse sandy loam, fine sandy loam, sand.	SC, SM, SP-SM, SM-SC	A-2, A-4	0	80-100	70-100	50-80	10-40	<30	NP-10
Bt Buttermilk	0-19	Silt loam	CL, CL-ML	A-4, A-6	0	100	100	90-100	80-100	25-40	5-20
	19-44	Silt loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	90-100	85-100	30-50	8-25
	44-60	Silt loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	90-100	85-100	30-50	8-25
Ca Canadian	0-17	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	98-100	94-100	36-65	<26	NP-7
	17-27	Fine sandy loam, loam, sandy loam.	SM, SC, ML, CL	A-4	0	100	98-100	94-100	36-85	<31	NP-10
	27-60	Fine sandy loam, sandy loam, loamy fine sand.	SM, ML, SC, CL	A-4, A-2	0	100	98-100	90-100	15-85	<31	NP-10
Cc, Cd Carey	0-10	Silt loam	CL, ML, CL-ML	A-4, A-6	0	100	98-100	90-100	65-95	20-32	3-15
	10-34	Silty clay loam, clay loam, loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	60-95	24-40	5-20
	34-60	Silt loam, loam, very fine sandy loam.	CL, ML, CL-ML, SM	A-4, A-6	0	97-100	90-100	83-100	44-85	20-37	3-18

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Frag-ments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plas-ticity index
	In				Pct					Pct	
Ch, Ck, Cm-------- Case	0-8	Clay loam--------	CL	A-6	0	90-100	90-100	85-100	55-85	30-40	10-20
	8-60	Clay loam, loam	CL	A-6, A-7-6	0	90-100	90-100	85-100	55-85	25-45	10-25
Co--------------- Clairemont	0-13	Silt loam--------	CL, CL-ML	A-4, A-6	0	100	98-100	85-100	60-90	20-35	4-17
	13-60	Silt loam, loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	65-95	20-40	4-20
Cp--------------- Clairemont	0-15	Loam-------------	CL, CL-ML	A-4, A-6	0	100	98-100	85-100	60-90	20-35	4-17
	15-60	Silt loam, loam, silty clay loam.	CL, CL-ML	A-4, A-6	0	100	98-100	95-100	65-95	20-40	4-20
Cr, Cs, Ct------- Clark	0-10	Clay loam--------	CL	A-6	0	100	95-100	90-100	50-90	30-40	10-20
	10-60	Loam, clay loam, very fine sandy loam.	CL	A-6	0	100	95-100	90-100	55-90	25-40	10-25
Cw*:											
Clark-----------	0-8	Clay loam--------	CL	A-6	0	100	95-100	90-100	50-90	30-40	10-20
	8-60	Loam, clay loam, very fine sandy loam.	CL	A-6	0	100	95-100	90-100	55-90	25-40	10-25
Kingsdown-------	0-10	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	95-100	65-100	30-55	<26	NP-7
	10-27	Fine sandy loam, sandy loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	95-100	65-100	25-55	<26	NP-7
	27-60	Fine sandy loam, loamy fine sand, loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	95-100	55-100	15-55	<26	NP-7
Dc--------------- Dale	0-22	Silt loam--------	CL, CL-ML	A-4, A-6	0	95-100	95-100	90-100	65-98	25-35	5-15
	22-60	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0	95-100	95-100	90-100	65-98	30-43	8-20
Ed, Ef----------- Elandco	0-31	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	85-95	20-40	4-20
	31-60	Silty clay loam, clay loam, silt loam.	CL, ML, CL-ML	A-4, A-6, A-7-6	0	100	100	95-100	65-95	20-45	4-25
Fe, Ff----------- Farnum	0-10	Loam-------------	CL-ML, CL	A-4, A-6	0	100	100	90-100	60-85	20-35	5-15
	10-36	Clay loam, sandy clay loam.	SC, CL	A-6, A-7-6	0	100	100	70-100	45-80	35-50	15-30
	36-60	Loam, clay loam, fine sandy loam.	SC, CL, SM-SC, CL-ML	A-6, A-2, A-4	0	100	95-100	65-100	30-80	20-35	5-15
He*:											
Hedville--------	0-19	Fine sandy loam	SM, ML, SC, CL	A-4, A-6, A-2	0-15	70-100	70-100	50-85	25-60	<35	NP-13
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Hr----------------- Holdrege	0-7	Silt loam--------	ML, CL, CL-ML	A-4, A-6	0	100	100	95-100	85-100	20-40	2-18
	7-24	Silty clay loam	CL	A-7, A-6	0	100	100	98-100	90-100	30-50	15-35
	24-29	Silt loam, silty clay loam.	CL	A-6, A-4	0	100	100	95-100	95-100	25-40	9-17
	29-60	Silt loam, loam	CL, ML	A-4, A-6	0	100	100	95-100	90-100	30-40	5-15
Kc----------------- Kanza	0-10	Loamy fine sand	SM, SP-SM	A-2, A-3	0	100	95-100	90-100	5-35	---	NP
	10-60	Loamy fine sand, fine sand, sand.	SM, SP-SM	A-2, A-3	0	90-100	90-100	80-100	5-35	---	NP
Kf----------------- Kaski	0-22	Loam--------------	CL, CL-ML	A-4, A-6, A-7	0	100	100	85-100	50-85	20-45	5-25
	22-37	Clay loam, loam, sandy loam.	CL, SC	A-4, A-6, A-7	0	100	95-100	85-100	45-85	25-45	7-25
	37-60	Clay loam, sandy loam, loam.	CL, ML, SM, SC	A-2, A-4, A-6	0	100	95-100	60-100	30-80	<35	NP-20
Kn, Ko------------ Kingsdown	0-10	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	95-100	65-100	30-55	<26	NP-7
	10-24	Fine sandy loam, sandy loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	95-100	65-100	25-55	<26	NP-7
	24-60	Fine sandy loam, loamy fine sand, loam.	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	95-100	55-100	15-55	<26	NP-7
Kr----------------- Krier	0-4	Loam--------------	CL, CL-ML	A-6, A-4	0	100	100	85-100	65-90	20-40	5-18
	4-11	Loam, clay loam, sandy loam.	CL, CL-ML, SM, SM-SC	A-2, A-4, A-6	0	100	95-100	70-100	20-85	20-40	2-20
	11-60	Sand, fine sand, coarse sand.	SM, SP-SM	A-2, A-3	0	100	95-100	55-75	5-35	---	NP
Ld*:											
Lancaster--------	0-16	Fine sandy loam	SM, SM-SC	A-4, A-2	0-5	95-100	90-100	60-85	30-50	<25	NP-7
	16-24	Sandy clay loam, clay loam, loam.	CL, SC	A-4, A-6, A-7-6	0	100	95-100	80-95	40-65	25-45	8-25
	24-31	Clay loam, loam, sandy loam.	CL-ML, SC, SM-SC, CL	A-4, A-6	0-10	95-100	90-100	80-100	36-80	20-35	5-15
	31	Weathered bedrock	---	---	---	---	---	---	---	---	---
Hedville---------	0-19	Fine sandy loam	SM, ML, SC, CL	A-4, A-6, A-2	0-15	70-100	70-100	50-85	25-60	<35	NP-13
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Le----------------- Lesho	0-10	Clay loam---------	CL	A-6, A-7-6	0	100	100	95-100	65-85	35-45	15-22
	10-30	Clay loam, loam	CL	A-4, A-6, A-7-6	0	100	100	85-100	65-95	25-45	7-22
	30-60	Sand, coarse sand, fine sand.	SM, SP-SM	A-1, A-2, A-3, A-4	0	100	95-100	30-85	5-45	---	NP
Ln----------------- Lincoln	0-10	Loamy sand--------	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	10-60	Stratified sand to clay loam.	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	---	NP
Lo----------------- Lincoln	0-12	Sandy loam--------	ML, SM, CL-ML, SM-SC	A-4	0	100	98-100	94-100	36-60	<24	NP-7
	12-60	Stratified sand to clay loam.	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	---	NP

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification: Unified	Classification: AASHTO	Fragments > 3 inches	Percentage passing sieve number--: 4	10	40	200	Liquid limit	Plasticity index
	In				Pct					Pct	
Lr*:											
Lincoln----------	0-8	Loamy sand--------	SM	A-2	0	100	98-100	90-100	15-35	---	NP
	8-60	Stratified sand to clay loam.	SM, SP-SM	A-2, A-3	0	100	98-100	82-100	5-35	---	NP
Krier-----------	0-4	Loam-------------	CL, CL-ML	A-6, A-4	0	100	100	85-100	65-90	20-40	5-18
	4-8	Loam, clay loam, sandy loam.	CL, CL-ML, SM, SM-SC	A-2, A-4, A-6	0	100	95-100	70-100	20-85	20-40	2-20
	8-60	Sand, fine sand, coarse sand.	SM, SP-SM	A-2, A-3	0	100	95-100	55-75	5-35	---	NP
Oa--------------- Obaro	0-35	Silty clay loam	CL, CL-ML	A-4, A-6	0	98-100	95-100	95-100	80-98	25-40	7-20
	35	Weathered bedrock	---	---	---	---	---	---	---	---	---
Ob*:											
Obaro-----------	0-35	Silty clay loam	CL, CL-ML	A-4, A-6	0	98-100	95-100	95-100	80-98	25-40	7-20
	35	Weathered bedrock	---	---	---	---	---	---	---	---	---
Rock outcrop.											
Oc--------------- Ost	0-8	Clay loam---------	CL	A-6	0	95-100	95-100	85-100	75-90	30-40	10-20
	8-16	Clay loam, loam	CL	A-4, A-6	0	95-100	90-100	85-100	55-90	30-40	9-18
	16-22	Clay loam, loam, sandy clay loam.	CL, SC	A-2, A-4, A-6	0	95-100	90-100	80-100	30-90	25-40	8-18
	22-60	Clay loam, loam, sandy loam.	CL, ML, SC, SM	A-2, A-4, A-6	0	85-100	85-100	80-100	30-90	<40	NP-18
Ph--------------- Port	0-10	Silt loam---------	CL	A-4, A-6	0	100	100	96-100	65-97	27-37	8-14
	10-60	Silty clay loam, clay loam, loam.	CL	A-4, A-6, A-7	0	100	100	96-100	65-98	27-43	8-20
Po, Pr----------- Pratt	0-9	Loamy fine sand	SM	A-2	0	100	95-100	70-100	15-35	---	NP
	9-31	Loamy fine sand, loamy sand, fine sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	90-100	15-40	<20	NP-6
	31-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
Pt*:											
Pratt-----------	0-9	Loamy fine sand	SM	A-2	0	100	95-100	70-100	15-35	---	NP
	9-31	Loamy fine sand, loamy sand, fine sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	90-100	15-40	<20	NP-6
	31-60	Loamy fine sand, fine sand.	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-35	---	NP
Tivoli----------	0-7	Loamy fine sand	SM	A-2	0	100	95-100	90-100	15-35	---	NP
	7-60	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-25	---	NP
Qr*, Qt*:											
Quinlan---------	0-14	Loam-------------	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	14	Weathered bedrock	---	---	---	---	---	---	---	---	---
Woodward--------	0-30	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	30	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Sb, Sc----------- St. Paul	0-8	Silt loam--------	CL, ML, CL-ML	A-4, A-6	0	100	100	95-100	65-98	21-35	2-13
	8-14	Silt loam, loam, silty clay loam.	CL	A-4, A-6	0	100	100	95-100	75-98	27-40	8-18
	14-32	Clay loam, silty clay loam.	CL	A-6, A-7	0	100	100	95-100	80-98	33-43	12-20
	32-40	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	95-100	75-98	27-50	8-26
	40-60	Silt loam, loam, silty clay loam.	CL	A-4, A-6	0	100	100	95-100	75-98	27-40	8-18
Sg, Sh, Sm------- Shellabarger	0-11	Sandy loam-------	SM, ML	A-4, A-2	0	95-100	95-100	75-100	30-55	<30	NP-5
	11-38	Sandy clay loam, sandy loam, fine sandy loam.	SC	A-4, A-6	0	95-100	85-100	70-90	35-50	25-40	8-20
	38-60	Sandy loam, fine sandy loam, sand.	SC, SM, SP-SM, SM-SC	A-2, A-4	0	80-100	70-100	50-80	10-40	<30	NP-10
Tv--------------- Tivoli	0-6	Fine sand--------	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-25	---	NP
	6-60	Fine sand, sand	SM, SP-SM	A-2, A-3	0	100	95-100	80-100	5-25	---	NP
Wd--------------- Waldeck	0-13	Fine sandy loam	SM, SM-SC, ML, CL-ML	A-2, A-4	0	100	95-100	75-100	25-55	<25	NP-5
	13-48	Fine sandy loam, sandy loam.	SM, SM-SC	A-2, A-4	0	100	95-100	70-100	30-50	<25	NP-5
	48-60	Fine sand, sand	SM, SP, SP-SM	A-1, A-2, A-3	0	90-100	80-100	40-60	1-35	---	NP
We--------------- Westview	0-15	Silt loam--------	CL	A-4, A-6	0	100	100	96-100	65-97	30-37	8-14
	15-50	Silty clay loam, clay loam.	CL	A-6, A-7	0	100	100	96-100	80-98	33-43	12-20
	50-60	Silt loam, loam, silty clay loam.	CL	A-4, A-6, A-7	0	100	100	96-100	65-98	30-43	8-20
Wf--------------- Wellsford	0-5	Clay-------------	CL, CH	A-7-6	0-5	95-100	95-100	85-100	75-95	45-60	20-35
	5-17	Clay, silty clay, clay loam.	CL, CH	A-7-6	0-5	95-100	95-100	85-100	75-95	45-70	20-40
	17	Weathered bedrock	---	---	---	---	---	---	---	---	---
Wo--------------- Woodward	0-30	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	30	Weathered bedrock	---	---	---	---	---	---	---	---	---
Ws*: Woodward--------	0-30	Loam-------------	ML, CL, CL-ML	A-4, A-6	0	100	100	90-100	51-95	<31	NP-12
	30	Weathered bedrock	---	---	---	---	---	---	---	---	---
Quinlan---------	0-14	Loam-------------	CL, ML, CL-ML	A-4, A-6	0	100	95-100	90-100	51-97	<37	NP-14
	14	Weathered bedrock	---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 15.--ENGINEERING INDEX PROPERTIES--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
Ye---------------- Yahola	0-12	Fine sandy loam	SM, ML, CL-ML, SM-SC	A-4	0	100	95-100	90-100	36-60	<26	NP-7
	12-40	Fine sandy loam, loam, very fine sandy loam.	SM, ML, CL, SC	A-4	0	100	95-100	90-100	36-85	<30	NP-10
	40-60	Stratified loam to loamy fine sand.	SM, ML, CL, SC	A-2, A-4	0	100	95-100	90-100	15-85	<30	NP-10
Ze---------------- Zenda	0-12	Clay loam--------	CL	A-6	0	100	95-100	85-100	55-80	30-40	10-20
	12-60	Loam, clay loam, sandy clay loam.	CL	A-6	0	100	95-100	85-100	55-80	25-40	10-25

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS

(The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Entries under "Wind erodibility group" and "Organic matter" apply only to the surface layer. Absence of an entry indicates that data were not available or were not estimated)

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ab, Ac-----------	0-8	20-27	1.30-1.65	0.6-2.0	0.15-0.20	6.6-8.4	<2	Moderate	0.37	5	6	1-3
Abilene	8-35	35-45	1.30-1.70	0.2-0.6	0.14-0.18	6.6-8.4	<2	Moderate	0.28			
	35-60	22-45	1.50-1.70	0.2-0.6	0.12-0.15	7.9-8.4	<2	Moderate	0.32			
An---------------	0-8	7-15	1.35-1.50	2.0-6.0	0.13-0.17	5.6-6.5	<2	Low--------	0.20	4	3	1-2
Albion	8-16	10-18	1.45-1.60	2.0-6.0	0.12-0.18	6.1-7.8	<2	Low--------	0.20			
	16-28	4-15	1.45-1.60	2.0-6.0	0.09-0.12	6.1-8.4	<2	Low--------	0.20			
	28-60	2-10	1.50-1.65	6.0-20	0.03-0.10	6.1-8.4	<2	Low--------	0.15			
As*:												
Albion-----------	0-8	7-15	1.35-1.50	2.0-6.0	0.13-0.17	5.6-6.5	<2	Low--------	0.20	4	3	1-2
	8-16	10-18	1.45-1.60	2.0-6.0	0.12-0.18	6.1-7.8	<2	Low--------	0.20			
	16-28	4-15	1.45-1.60	2.0-6.0	0.09-0.12	6.1-8.4	<2	Low--------	0.20			
	28-60	2-10	1.50-1.65	6.0-20	0.03-0.10	6.1-8.4	<2	Low--------	0.15			
Shellabarger----	0-11	8-16	1.35-1.50	0.6-2.0	0.13-0.21	5.1-6.5	<2	Low--------	0.20	5	3	1-2
	11-38	18-27	1.45-1.60	0.6-2.0	0.16-0.18	6.1-7.8	<2	Low--------	0.28			
	38-60	3-18	1.50-1.65	0.6-2.0	0.05-0.16	6.1-8.4	<2	Low--------	0.28			
Bt---------------	0-19	18-26	1.30-1.45	0.6-2.0	0.15-0.24	7.4-8.4	2-8	Low--------	0.32	5	6	1-3
Buttermilk	19-44	18-35	1.35-1.50	0.6-2.0	0.10-0.15	7.4-8.4	4-16	Moderate	0.43			
	44-60	18-35	1.35-1.50	0.6-2.0	0.10-0.15	7.4-8.4	2-8	Moderate	0.43			
Ca---------------	0-17	5-18	1.30-1.60	2.0-6.0	0.10-0.15	5.6-7.3	<2	Low--------	0.20	5	3	1-3
Canadian	17-27	10-18	1.40-1.70	2.0-6.0	0.10-0.20	6.1-8.4	<2	Low--------	0.20			
	27-60	5-18	1.40-1.70	2.0-20	0.07-0.20	6.1-8.4	<2	Low--------	0.20			
Cc, Cd-----------	0-10	10-25	1.35-1.55	0.6-2.0	0.15-0.20	6.6-7.8	<2	Low--------	0.32	5	6	1-3
Carey	10-34	20-35	1.40-1.60	0.6-2.0	0.15-0.20	6.6-8.4	<2	Low--------	0.43			
	34-60	15-27	1.40-1.60	0.6-2.0	0.10-0.18	7.9-8.4	<2	Low--------	0.43			
Ch, Ck, Cm-------	0-8	27-32	1.35-1.45	0.6-2.0	0.17-0.22	7.4-8.4	<2	Low--------	0.32	5	4L	.5-2
Case	8-60	18-35	1.35-1.70	0.6-2.0	0.15-0.19	7.4-8.4	<2	Moderate	0.32			
Co---------------	0-13	15-27	1.40-1.60	0.6-2.0	0.16-0.22	7.4-8.4	<2	Low--------	0.37	5	4L	<2
Clairemont	13-60	18-35	1.40-1.65	0.6-2.0	0.16-0.22	7.9-8.4	<2	Low--------	0.43			
Cp---------------	0-15	15-27	1.40-1.60	0.6-2.0	0.16-0.22	7.9-8.4	<2	Low--------	0.37	5	4L	<2
Clairemont	15-60	18-35	1.40-1.65	0.6-2.0	0.16-0.22	7.9-8.4	<2	Low--------	0.43			
Cr, Cs, Ct-------	0-10	27-32	1.35-1.45	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.28	5	4L	1-2
Clark	10-60	18-35	1.35-1.70	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.28			
Cw*:												
Clark------------	0-8	27-32	1.35-1.45	0.6-2.0	0.17-0.22	7.4-8.4	<2	Moderate	0.28	5	4L	1-2
	8-60	18-35	1.35-1.70	0.6-2.0	0.14-0.19	7.4-8.4	<2	Moderate	0.28			
Kingsdown--------	0-10	8-18	1.40-1.50	2.0-6.0	0.15-0.18	6.6-8.4	<2	Low--------	0.20	5	3	1-2
	10-27	8-18	1.45-1.55	2.0-6.0	0.14-0.17	7.4-8.4	<2	Low--------	0.20			
	27-60	5-18	1.45-1.55	2.0-6.0	0.10-0.17	7.4-8.4	<2	Low--------	0.20			
Dc---------------	0-22	15-26	1.30-1.50	0.6-2.0	0.15-0.24	6.1-7.8	<2	Low--------	0.32	5	6	1-3
Dale	22-60	18-35	1.40-1.70	0.6-2.0	0.15-0.24	7.4-8.4	<2	Moderate	0.37			
Ed, Ef-----------	0-31	18-27	1.30-1.50	0.6-2.0	0.15-0.22	6.6-8.4	<2	Moderate	0.32	5	6	1-3
Elandco	31-60	18-35	1.30-1.50	0.6-2.0	0.15-0.22	7.4-8.4	<2	Moderate	0.43			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea- bility	Available water capacity	Soil reaction	Salinity	Shrink- swell potential	Erosion factors K	Erosion factors T	Wind erodi- bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Fe, Ff----------- Farnum	0-10	14-27	1.35-1.45	0.6-2.0	0.19-0.22	5.6-7.3	<2	Low-------	0.28	5	6	1-3
	10-36	25-35	1.40-1.50	0.6-2.0	0.15-0.19	6.1-8.4	<2	Moderate	0.28			
	36-60	12-29	1.40-1.55	0.6-2.0	0.13-0.16	6.6-8.4	<2	Low-------	0.28			
He*:												
Hedville--------	0-19	8-22	1.35-1.50	0.6-2.0	0.14-0.20	5.6-7.3	<2	Low-------	0.32	2	3	1-4
	19	---	---	---	---	---	---	----------	----			
Rock outcrop.												
Hr--------------- Holdrege	0-7	15-25	1.40-1.60	0.6-2.0	0.22-0.24	5.6-7.3	<2	Moderate	0.32	5	6	1-3
	7-24	28-35	1.20-1.40	0.6-2.0	0.18-0.20	6.1-7.8	<2	Moderate	0.43			
	24-29	18-30	1.30-1.50	0.6-2.0	0.17-0.20	6.6-7.8	<2	Moderate	0.43			
	29-60	15-20	1.40-1.60	0.6-2.0	0.20-0.22	7.4-8.4	<2	Moderate	0.43			
Kc--------------- Kanza	0-10	3-12	1.50-1.70	6.0-20	0.08-0.13	5.6-6.5	<2	Low-------	0.17	5	2	1-3
	10-60	1-12	1.50-1.70	6.0-20	0.06-0.11	5.6-8.4	<2	Low-------	0.17			
Kf--------------- Kaski	0-22	13-27	1.35-1.45	0.6-2.0	0.18-0.22	5.6-7.3	<2	Moderate	0.28	5	6	1-3
	22-37	18-35	1.40-1.50	0.6-2.0	0.13-0.19	5.6-7.8	<2	Moderate	0.28			
	37-60	8-30	1.45-1.55	0.6-2.0	0.13-0.19	5.6-8.4	<2	Low-------	0.28			
Kn, Ko----------- Kingsdown	0-10	8-18	1.40-1.50	2.0-6.0	0.15-0.18	6.6-8.4	<2	Low-------	0.20	5	3	1-2
	10-24	8-18	1.45-1.55	2.0-6.0	0.14-0.17	7.4-8.4	<2	Low-------	0.20			
	24-60	5-18	1.45-1.55	2.0-6.0	0.10-0.17	7.4-8.4	<2	Low-------	0.20			
Kr--------------- Krier	0-4	12-27	1.30-1.40	2.0-6.0	0.20-0.22	7.4-9.0	2-8	Low-------	0.32	3	4L	.5-2
	4-11	10-32	1.40-1.50	2.0-6.0	0.13-0.18	7.9-9.0	4-16	Low-------	0.32			
	11-60	1-5	1.45-1.55	6.0-20	0.03-0.07	7.4-9.0	2-8	Low-------	0.15			
Ld*:												
Lancaster-------	0-16	5-20	1.40-1.50	2.0-6.0	0.13-0.18	5.6-6.5	<2	Low-------	0.28	4	3	1-4
	16-24	18-35	1.35-1.50	0.6-2.0	0.15-0.19	5.6-7.3	<2	Moderate	0.28			
	24-31	12-30	1.40-1.55	0.6-2.0	0.15-0.19	6.1-7.3	<2	Low-------	0.28			
	31	---	---	---	---	---	---	----------	----			
Hedville--------	0-19	8-22	1.35-1.50	0.6-2.0	0.14-0.20	5.6-7.3	<2	Low-------	0.32	2	3	1-4
	19	---	---	---	---	---	---	----------	----			
Le--------------- Lesho	0-10	28-35	1.30-1.40	0.2-0.6	0.17-0.19	7.4-8.4	<4	Moderate	0.28	4	4L	1-3
	10-30	18-35	1.35-1.45	0.2-0.6	0.16-0.19	7.4-8.4	<4	Moderate	0.28			
	30-60	1-8	1.45-1.55	>2.0	0.02-0.10	7.4-9.0	<4	Low-------	0.15			
Ln--------------- Lincoln	0-10	5-15	1.35-1.50	6.0-20	0.06-0.11	7.4-8.4	<2	Low-------	0.17	5	2	<.5
	10-60	5-15	1.30-1.60	6.0-20	0.02-0.08	7.9-8.4	<2	Low-------	0.17			
Lo--------------- Lincoln	0-12	10-18	1.30-1.60	6.0-20	0.10-0.15	7.4-8.4	<2	Low-------	0.24	5	3	<1
	12-60	5-15	1.30-1.60	6.0-20	0.02-0.08	7.9-8.4	<2	Low-------	0.17			
Lr*:												
Lincoln---------	0-8	5-15	1.35-1.50	6.0-20	0.06-0.11	7.4-8.4	<2	Low-------	0.17	5	2	<.5
	8-60	5-15	1.30-1.60	6.0-20	0.02-0.08	7.9-8.4	<2	Low-------	0.17			
Krier-----------	0-4	12-27	1.30-1.40	2.0-6.0	0.20-0.22	7.4-9.0	2-8	Low-------	0.32	3	4L	.5-2
	4-8	10-32	1.40-1.50	2.0-6.0	0.13-0.18	7.9-9.0	4-16	Low-------	0.32			
	8-60	1-5	1.45-1.55	6.0-20	0.03-0.07	7.4-9.0	2-8	Low-------	0.15			
Oa--------------- Obaro	0-35	27-35	1.30-1.45	0.6-2.0	0.14-0.20	7.9-8.4	<2	Low-------	0.43	3	4L	<1
	35	---	---	---	---	---	---	----------	----			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodibility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ob*:												
Obaro	0-35	27-35	1.30-1.45	0.6-2.0	0.14-0.20	7.9-8.4	<2	Low	0.43	3	4L	<1
	35	---	---	---	---	---	---	---	---			
Rock outcrop.												
Oc	0-8	27-30	1.35-1.40	0.2-0.6	0.15-0.20	6.1-8.4	<2	Low	0.28	5	6	1-3
Ost	8-16	20-34	1.45-1.65	0.2-0.6	0.15-0.20	6.6-8.4	<2	Moderate	0.32			
	16-22	18-34	1.40-1.60	0.2-0.6	0.15-0.20	7.4-8.4	<2	Moderate	0.32			
	22-60	5-30	1.40-1.60	0.2-0.6	0.13-0.20	7.4-8.4	<2	Low	0.32			
Ph	0-10	12-26	1.30-1.55	0.6-2.0	0.15-0.24	5.6-7.8	<2	Low	0.32	5	6	1-3
Port	10-60	20-35	1.30-1.60	0.6-2.0	0.15-0.24	6.1-8.4	<2	Moderate	0.37			
Po, Pr	0-9	2-8	1.40-1.55	6.0-20	0.10-0.13	5.6-7.3	<2	Low	0.17	5	2	.5-1
Pratt	9-31	4-11	1.45-1.55	6.0-20	0.09-0.12	5.6-7.3	<2	Low	0.17			
	31-60	1-8	1.45-1.60	6.0-20	0.08-0.12	6.1-7.3	<2	Low	0.17			
Pt*:												
Pratt	0-9	2-8	1.40-1.55	6.0-20	0.10-0.13	5.6-7.3	<2	Low	0.17	5	2	.5-1
	9-31	4-11	1.45-1.55	6.0-20	0.09-0.12	5.6-7.3	<2	Low	0.17			
	31-60	1-8	1.45-1.60	6.0-20	0.08-0.12	6.1-7.3	<2	Low	0.17			
Tivoli	0-7	5-10	1.35-1.50	6.0-20.0	0.07-0.11	6.1-7.8	<2	Low	0.17	5	2	<1
	7-60	1-10	1.50-1.70	6.0-20.0	0.02-0.08	6.1-8.4	<2	Low	0.17			
Qr*, Qt*:												
Quinlan	0-14	15-27	1.30-1.55	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low	0.32	2	4L	<1
	14	---	---	---	---	---	---	---	---			
Woodward	0-30	10-18	1.30-1.60	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low	0.32	4	4L	.5-2
	30	---	---	---	---	---	---	---	---			
Sb, Sc	0-8	15-27	1.30-1.55	0.6-2.0	0.15-0.24	6.6-7.8	<2	Low	0.32	5	6	1-3
St. Paul	8-14	18-35	1.40-1.70	0.6-2.0	0.15-0.22	6.6-7.8	<2	Low	0.37			
	14-32	27-35	1.45-1.70	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate	0.32			
	32-40	20-40	1.40-1.70	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate	0.37			
	40-60	15-35	1.40-1.70	0.2-2.0	0.15-0.22	7.9-8.4	<2	Moderate	0.37			
Sg, Sh, Sm	0-11	8-16	1.35-1.50	0.6-2.0	0.13-0.21	5.1-6.5	<2	Low	0.20	5	3	1-2
Shellabarger	11-38	18-27	1.45-1.60	0.6-2.0	0.16-0.18	6.1-7.8	<2	Low	0.28			
	38-60	3-18	1.50-1.65	0.6-2.0	0.05-0.16	6.1-8.4	<2	Low	0.28			
Tv	0-6	1-10	1.35-1.50	6.0-20.0	0.02-0.08	6.1-7.8	<2	Low	0.15	5	1	<1
Tivoli	6-60	1-10	1.50-1.70	6.0-20.0	0.02-0.08	6.1-8.4	<2	Low	0.17			
Wd	0-13	8-16	1.50-1.60	2.0-6.0	0.14-0.18	7.4-8.4	<2	Low	0.20	5	3	1-2
Waldeck	13-48	8-16	1.50-1.60	2.0-6.0	0.12-0.17	7.4-8.4	<2	Low	0.20			
	48-60	1-4	1.55-1.65	6.0-20	0.05-0.07	7.4-8.4	<2	Low	0.20			
We	0-15	18-27	1.30-1.55	0.6-2.0	0.15-0.24	6.6-8.4	<2	Low	0.37	5	6	1-3
Westview	15-50	27-35	1.45-1.70	0.2-0.6	0.15-0.22	7.4-8.4	<2	Moderate	0.32			
	50-60	18-35	1.45-1.70	0.6-2.0	0.15-0.24	7.9-8.4	<2	Moderate	0.37			
Wf	0-5	40-60	1.35-1.55	<0.06	0.12-0.14	6.6-8.4	<2	High	0.32	2	4	.5-2
Wellsford	5-17	35-60	1.45-1.65	<0.06	0.10-0.12	7.9-8.4	<2	High	0.32			
	17	---	---	---	---	---	---	---	---			
Wo	0-30	10-18	1.30-1.60	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low	0.32	4	4L	.5-2
Woodward	30	---	---	---	---	---	---	---	---			

See footnote at end of table.

TABLE 16.--PHYSICAL AND CHEMICAL PROPERTIES OF THE SOILS--Continued

Soil name and map symbol	Depth	Clay	Moist bulk density	Permea-bility	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T	Wind erodi-bility group	Organic matter
	In	Pct	g/cc	In/hr	In/in	pH	mmhos/cm					Pct
Ws*:												
Woodward--------	0-30	10-18	1.30-1.60	0.6-2.0	0.13-0.20	6.6-8.4	<2	Low--------	0.32	4	4L	.5-2
	30	---	---	---	---	---	---	-----------	----			
Quinlan---------	0-14	15-27	1.30-1.55	0.6-2.0	0.13-0.24	7.4-8.4	<2	Low--------	0.32	2	4L	<1
	14	---	---	---	---	---	---	-----------	----			
Ye--------------- Yahola	0-12	10-18	1.30-1.60	2.0-6.0	0.11-0.15	7.4-8.4	<2	Low--------	0.24	5	3	.5-1
	12-40	5-18	1.40-1.70	2.0-6.0	0.11-0.20	7.9-8.4	<2	Low--------	0.32			
	40-60	5-18	1.50-1.70	2.0-6.0	0.07-0.20	7.9-8.4	<2	Low--------	0.32			
Ze--------------- Zenda	0-12	27-32	1.45-1.55	0.6-2.0	0.17-0.22	6.6-8.4	<4	Moderate	0.28	5	6	1-3
	12-60	18-35	1.45-1.60	0.6-2.0	0.15-0.19	7.4-8.4	<4	Moderate	0.28			

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 17.--SOIL AND WATER FEATURES

("Flooding" and "water table" and terms such as "rare," "brief," and "apparent" are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern or that data were not estimated)

Soil name and map symbol	Hydro-logic group	Flooding			High water table			Bedrock		Risk of corrosion	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hard-ness	Uncoated steel	Concrete
					Ft			In			
Ab, Ac------------ Abilene	C	None--------	---	---	>6.0	---	---	>60	---	High-----	Low.
An---------------- Albion	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
As*:											
Albion-----------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
Shellabarger-----	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate.
Bt---------------- Buttermilk	B	Rare--------	---	---	4.5-6.0	Apparent	Nov-May	>60	---	High-----	Moderate.
Ca---------------- Canadian	B	Rare--------	---	---	>6.0	---	---	>60	---	Low------	Low.
Cc, Cd------------ Carey	B	None--------	---	---	>6.0	---	---	40-70	Soft	Moderate	Low.
Ch, Ck, Cm-------- Case	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Co---------------- Clairemont	B	Occasional	Very brief	Apr-Jun	>6.0	---	---	>60	---	Moderate	Low.
Cp---------------- Clairemont	B	Frequent----	Brief-----	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low.
Cr, Cs, Ct-------- Clark	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Cw*:											
Clark------------	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Kingsdown--------	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
Dc---------------- Dale	B	Rare--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Fd---------------- Elandco	B	Occasional	Very brief	Apr-Jun	>6.0	---	---	>60	---	Moderate	Low.
Ef---------------- Elandco	B	Frequent----	Brief-----	Apr-Sep	>6.0	---	---	>60	---	Moderate	Low.
Fe, Ff------------ Farnum	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
He*:											
Hedville---------	D	None--------	---	---	>6.0	---	---	4-20	Hard	Low------	Moderate.
Rock outcrop.											
Hr---------------- Holdrege	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In			
Kc----------------- Kanza	D	Frequent----	Brief-----	Apr-Sep	0-3.0	Apparent	Dec-Mar	>60	---	High-----	Moderate.
Kf----------------- Kaski	B	Rare--------	---	---	>6.0	---	---	>60	---	Low------	Low.
Kn, Ko------------- Kingsdown	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
Kr----------------- Krier	D	Occasional	Very brief	Apr-Jun	1.0-3.0	Apparent	Nov-May	>60	---	High-----	Low.
Ld*:											
Lancaster---------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Moderate.
Hedville----------	D	None--------	---	---	>6.0	---	---	4-20	Hard	Low------	Moderate.
Le----------------- Lesho	C	Occasional	Very brief	Apr-Jun	2.0-4.0	Apparent	Mar-Jun	>60	---	High-----	Low.
Ln, Lo------------- Lincoln	A	Occasional	Very brief to brief.	Apr-Jun	5.0-8.0	Apparent	Nov-May	>60	---	Low------	Low.
Lr*:											
Lincoln-----------	A	Occasional	Very brief to brief.	Apr-Jun	5.0-8.0	Apparent	Nov-May	>60	---	Low------	Low.
Krier-------------	D	Occasional	Very brief	Apr-Jun	1.0-3.0	Apparent	Nov-May	>60	---	High-----	Low.
Oa----------------- Obaro	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Low.
Ob*:											
Obaro-------------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Low.
Rock outcrop.											
Oc----------------- Ost	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Ph----------------- Port	B	Occasional	Very brief to brief.	Apr-Jun	>6.0	---	---	>60	---	Moderate	Low.
Po, Pr------------- Pratt	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate.
Pt*:											
Pratt-------------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate.
Tivoli------------	A	None--------	---	---	>6.0	---	---	>60	---	Low------	Low.
Qr*, Qt*:											
Quinlan-----------	C	None--------	---	---	>6.0	---	---	10-20	Soft	Moderate	Low.
Woodward----------	B	None--------	---	---	>6.0	---	---	20-40	Soft	Low------	Low.
Sb, Sc------------- St. Paul	B	None--------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Sg, Sh, Sm--------- Shellabarger	B	None--------	---	---	>6.0	---	---	>60	---	Low------	Moderate.

See footnote at end of table.

TABLE 17.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding: Frequency	Flooding: Duration	Flooding: Months	High water table: Depth	High water table: Kind	High water table: Months	Bedrock: Depth	Bedrock: Hardness	Risk of corrosion: Uncoated steel	Risk of corrosion: Concrete
					Ft			In			
Tv----------------- Tivoli	A	None---------	---	---	>6.0	---	---	>60	---	Low-------	Low.
Wd----------------- Waldeck	C	Occasional	Very brief	Apr-Jun	2.0-4.0	Apparent	Oct-Apr	>60	---	Moderate	Low.
We----------------- Westview	B	None---------	---	---	>6.0	---	---	>60	---	Moderate	Low.
Wf----------------- Wellsford	D	None---------	---	---	>6.0	---	---	10-20	Soft	High------	Low.
Wo----------------- Woodward	B	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	Low.
Ws*:											
Woodward----------	B	None---------	---	---	>6.0	---	---	20-40	Soft	Low-------	Low.
Quinlan-----------	C	None---------	---	---	>6.0	---	---	10-20	Soft	Moderate	Low.
Ye----------------- Yahola	B	Occasional	Very brief	Apr-Jun	>6.0	---	---	>60	---	Low-------	Low.
Ze----------------- Zenda	C	Occasional	Very brief	Apr-Jun	2.0-4.0	Apparent	Oct-Apr	>60	---	High------	Low.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 18.--ENGINEERING INDEX TEST DATA

(Dashes indicate that data were not available. LL means liquid limit; PI, plasticity index; MD, maximum dry density; and OM, optimum moisture)

Soil name, report number, horizon, and depth in inches	Classification		Grain-size distribution							LL	PI	Moisture density	
			Percentage passing sieve--				Percentage smaller than*--					MD	OM
	AASHTO	Unified	No. 4	No. 10	No. 40	No. 200	.02 mm	.005 mm	.002 mm				
										Pct		Lb/ft^3	Pct
Case clay loam: (S82KS-033-001)													
A------ 0 to 8	A-4	CL	100	100	89	58	22	8	3	31	10	109	15
Bw----- 8 to 16	A-6	CL	100	100	92	66	30	16	9	32	13	108	14
C------ 27 to 60	A-6	CL	100	100	89	59	27	13	7	28	11	117	13
Kingsdown fine sandy loam: (S82KS-033-003)													
A------ 0 to 10	A-4	SM	100	100	88	42	14	4	2	21	4	117	11
Bw----- 10 to 24	A-2-4	SC	100	100	88	25	14	8	5	22	7	121	10
C------ 24 to 60	A-2-4	SC	100	100	82	30	19	12	7	22	7	121	12
St. Paul silt loam: (S82KS-033-002)													
A------ 0 to 8	A-4	CL	100	100	100	91	37	13	7	33	10	98	16
Bt2---- 22 to 32	A-6	CL	100	100	100	95	57	29	20	40	20	98	21
C------ 40 to 60	A-6	CL	100	100	100	89	51	22	11	35	17	105	17

* The results obtained by engineering analysis may differ from those obtained by USDA analysis of texture because different procedures were used.

TABLE 19.--CLASSIFICATION OF THE SOILS

(An asterisk in the first column indicates that the soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series)

Soil name	Family or higher taxonomic class
Abilene	Fine, mixed, thermic Pachic Argiustolls
Albion	Coarse-loamy, mixed, thermic Udic Argiustolls
Buttermilk	Fine-silty, mixed, thermic Pachic Haplustolls
Canadian	Coarse-loamy, mixed, thermic Udic Haplustolls
Carey	Fine-silty, mixed, thermic Typic Argiustolls
Case	Fine-loamy, mixed, thermic Typic Ustochrepts
Clairemont	Fine-silty, mixed (calcareous), thermic Typic Ustifluvents
Clark	Fine-loamy, mixed, thermic Typic Calciustolls
Dale	Fine-silty, mixed, thermic Pachic Haplustolls
Elandco	Fine-silty, mixed, thermic Cumulic Haplustolls
Farnum	Fine-loamy, mixed, thermic Pachic Argiustolls
*Hedville	Loamy, mixed, mesic Lithic Haplustolls
*Holdrege	Fine-silty, mixed, mesic Typic Argiustolls
Kanza	Mixed, thermic Mollic Psammaquents
Kaski	Fine-loamy, mixed, thermic Cumulic Haplustolls
Kingsdown	Coarse-loamy, mixed, thermic Entic Haplustolls
Krier	Sandy, mixed, thermic Aeric Halaquepts
*Lancaster	Fine-loamy, mixed, mesic Udic Argiustolls
Lesho	Fine-loamy over sandy or sandy-skeletal, mixed, thermic Fluvaquentic Haplustolls
Lincoln	Sandy, mixed, thermic Typic Ustifluvents
Obaro	Fine-silty, mixed, thermic Typic Ustochrepts
Ost	Fine-loamy, mixed, thermic Typic Argiustolls
Port	Fine-silty, mixed, thermic Cumulic Haplustolls
Pratt	Sandy, mixed, thermic Psammentic Haplustalfs
Quinlan	Loamy, mixed, thermic, shallow Typic Ustochrepts
St. Paul	Fine-silty, mixed, thermic Pachic Argiustolls
Shellabarger	Fine-loamy, mixed, thermic Udic Argiustolls
Tivoli	Mixed, thermic Typic Ustipsamments
Waldeck	Coarse-loamy, mixed, thermic Fluvaquentic Haplustolls
Wellsford	Clayey, mixed, thermic, shallow Typic Ustochrepts
Westview	Fine-silty, mixed, thermic Pachic Argiustolls
Woodward	Coarse-silty, mixed, thermic Typic Ustochrepts
Yahola	Coarse-loamy, mixed (calcareous), thermic Typic Ustifluvents
Zenda	Fine-loamy, mixed, thermic Fluvaquentic Haplustolls

Interpretive Groups

INTERPRETIVE GROUPS

(Dashes indicate that the soil was not assigned to the interpretive group)

Map symbol	Map unit	Land capability* N	Land capability* I	Prime farmland*	Range site
Ab	Abilene silt loam, 0 to 1 percent slopes	IIc	---	Yes	Loamy Upland.
Ac	Abilene silt loam, 1 to 3 percent slopes	IIe	---	Yes	Loamy Upland.
An	Albion sandy loam, 1 to 4 percent slopes	IIIe	IIIe	Yes**	Sandy.
As	Albion-Shellabarger sandy loams, 4 to 15 percent slopes	VIe	---	No	
	Albion				Sandy.
	Shellabarger				Sandy.
Bt	Buttermilk silt loam	IIIs	---	No	Saline Lowland.
Ca	Canadian fine sandy loam	IIe	IIe	Yes	Sandy Terrace.
Cc	Carey silt loam, 0 to 2 percent slopes	IIc	---	Yes	Loamy Upland.
Cd	Carey silt loam, 2 to 5 percent slopes	IIIe	---	Yes	Loamy Upland.
Ch	Case clay loam, 1 to 3 percent slopes	IIIe	---	Yes	Limy Upland.
Ck	Case clay loam, 3 to 7 percent slopes	IVe	---	Yes	Limy Upland.
Cm	Case clay loam, 7 to 15 percent slopes	VIe	---	No	Limy Upland.
Co	Clairemont silt loam, occasionally flooded	IIw	---	Yes	Loamy Lowland.
Cp	Clairemont loam, channeled	Vw	---	No	Loamy Lowland.
Cr	Clark clay loam, 0 to 1 percent slopes	IIc	I	Yes	Limy Upland.
Cs	Clark clay loam, 1 to 3 percent slopes	IIIe	---	Yes	Limy Upland.
Ct	Clark clay loam, 3 to 6 percent slopes	IVe	---	Yes	Limy Upland.
Cw	Clark-Kingsdown complex, 5 to 12 percent slopes	VIe	---	No	
	Clark				Limy Upland.
	Kingsdown				Sandy.
Dc	Dale silt loam	IIc	---	Yes	Loamy Terrace.
Ed	Elandco silt loam, occasionally flooded	IIw	---	Yes	Loamy Lowland.
Ef	Elandco silt loam, channeled	Vw	---	No	Loamy Lowland.
Fe	Farnum loam, 0 to 1 percent slopes	IIc	---	Yes	Loamy Upland.
Ff	Farnum loam, 1 to 3 percent slopes	IIe	---	Yes	Loamy Upland.
He	Hedville-Rock outcrop complex, 8 to 30 percent slopes	VIIs	---	No	
	Hedville				Shallow Sandstone.
	Rock outcrop.				
Hr	Holdrege silt loam, 1 to 3 percent slopes	IIe	---	Yes	Loamy Upland.
Kc	Kanza loamy fine sand, frequently flooded	Vw	---	No	Subirrigated.
Kf	Kaski loam	IIc	---	Yes	Loamy Terrace.
Kn	Kingsdown fine sandy loam, 0 to 2 percent slopes	IIe	IIe	Yes	Sandy.

See footnotes at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol	Map unit	Land capability* N	Land capability* I	Prime farmland*	Range site
Ko	Kingsdown fine sandy loam, 2 to 5 percent slopes	IIIe	IIIe	Yes	Sandy.
Kr	Krier loam	VIs	---	No	Saline Subirrigated.
Ld	Lancaster-Hedville fine sandy loams, 4 to 12 percent slopes	VIe	---	No	
	Lancaster				Loamy Upland.
	Hedville				Shallow Sandstone.
Le	Lesho clay loam, occasionally flooded	IIIw	---	Yes	Subirrigated.
Ln	Lincoln loamy sand, occasionally flooded	VIw	---	No	Sandy Lowland.
Lo	Lincoln sandy loam, occasionally flooded	VIw	---	No	Sandy Lowland.
Lr	Lincoln-Krier complex, occasionally flooded	VIw	---	No	
	Lincoln				Sandy Lowland.
	Krier				Saline Subirrigated.
Oa	Obaro silty clay loam, 5 to 12 percent slopes	VIe	---	No	Loamy Upland.
Ob	Obaro-Rock outcrop complex, 10 to 30 percent slopes	VIIs	---	No	
	Obaro				Loamy Upland.
	Rock outcrop.				
Oc	Ost clay loam, 2 to 6 percent slopes	IIIe	---	Yes	Loamy Upland.
Ph	Port silt loam, occasionally flooded	IIw	---	Yes	Loamy Lowland.
Po	Pratt loamy fine sand, rolling	IVe	---	No	Sands.
Pr	Pratt loamy fine sand, undulating	IIIe	IIIe	No	Sands.
Pt	Pratt-Tivoli loamy fine sands, rolling	VIe	---	No	
	Pratt				Sands.
	Tivoli				Sands.
Qr	Quinlan-Woodward loams, 6 to 15 percent slopes	VIe	---	No	
	Quinlan				Shallow Prairie.
	Woodward				Loamy Upland.
Qt	Quinlan-Woodward loams, 15 to 30 percent slopes	VIIe	---	No	
	Quinlan				Shallow Prairie.
	Woodward				Loamy Upland.
Sb	St. Paul silt loam, 0 to 1 percent slopes	IIc	---	Yes	Loamy Upland.
Sc	St. Paul silt loam, 1 to 3 percent slopes	IIe	---	Yes	Loamy Upland.
Sg	Shellabarger sandy loam, 0 to 1 percent slopes	IIe	IIe	Yes	Sandy.
Sh	Shellabarger sandy loam, 1 to 3 percent slopes	IIe	IIe	Yes	Sandy.
Sm	Shellabarger sandy loam, 3 to 6 percent slopes	IIIe	---	Yes	Sandy.
Tv	Tivoli fine sand, hilly	VIIe	---	No	Choppy Sands.
Wd	Waldeck fine sandy loam, occasionally flooded	IIIw	---	Yes	Subirrigated.
We	Westview silt loam, 0 to 1 percent slopes	IIc	I	Yes	Loamy Upland.
Wf	Wellsford clay, 6 to 25 percent slopes	VIe	---	No	Blue Shale.

See footnotes at end of table.

INTERPRETIVE GROUPS--Continued

Map symbol	Map unit	Land capability* N	Land capability* I	Prime farmland*	Range site
Wo	Woodward loam, 1 to 3 percent slopes	IIe	---	Yes	Loamy Upland.
Ws	Woodward-Quinlan loams, 3 to 6 percent slopes	IVe	---	No	
	Woodward				Loamy Upland.
	Quinlan				Shallow Prairie.
Ye	Yahola fine sandy loam, occasionally flooded	IIw	---	Yes	Sandy Lowland.
Ze	Zenda clay loam, occasionally flooded	IIw	---	Yes	Subirrigated.

* A soil complex is treated as a single management unit in the land capability and prime farmland columns. The N column is for nonirrigated soils; the I column is for irrigated soils.
** If irrigated.

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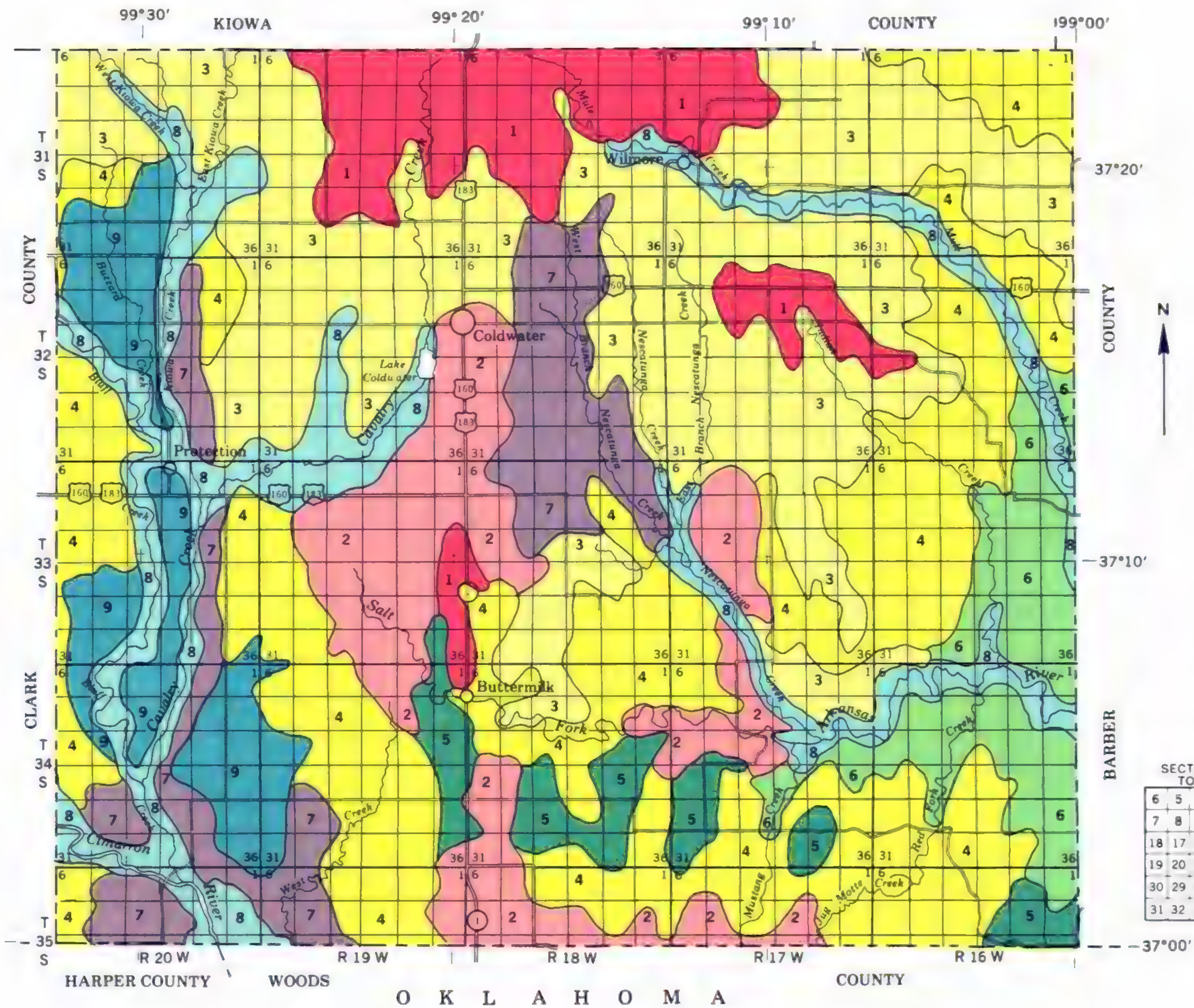


SOIL LEGEND

1 ABILENE-CLARK-CASE ASSOCIATION: Deep, nearly level to strongly sloping, well drained soils that have a dominantly clayey or loamy subsoil; on uplands

2 CLARK-CASE-KINGSDOWN ASSOCIATION: Deep, nearly level to strongly sloping, well drained soils that have a loamy subsoil; on uplands

3 ALBION-SHELLABARGER ASSOCIATION: Deep, nearly level to strongly sloping, somewhat excessively drained and well drained soils that have a dominantly loamy subsoil; on uplands

4 QUINLAN-WOODWARD-CAREY ASSOCIATION: Shallow to deep, nearly level to steep, well drained soils that have a loamy subsoil; on uplands

5 ST. PAUL-CAREY-QUINLAN ASSOCIATION: Deep and shallow, nearly level to steep, well drained soils that have a silty or loamy subsoil; on uplands

6 OBARO-ABILENE ASSOCIATION: Moderately deep and deep, nearly level to strongly sloping, well drained soils that have a clayey or silty subsoil; on uplands

7 PRATT-TIVOLI-KINGSDOWN ASSOCIATION: Deep, nearly level to hilly, well drained and excessively drained soils that have a sandy or loamy subsoil or that are sandy throughout; on uplands

8 LINCOLN-WALDECK ASSOCIATION: Deep, nearly level, somewhat excessively drained and somewhat poorly drained soils that have a sandy or loamy subsoil; on flood plains

9 WESTVIEW-DALE ASSOCIATION: Deep, nearly level, well drained soils that have a silty subsoil; on stream terraces

Compiled 1987

SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.

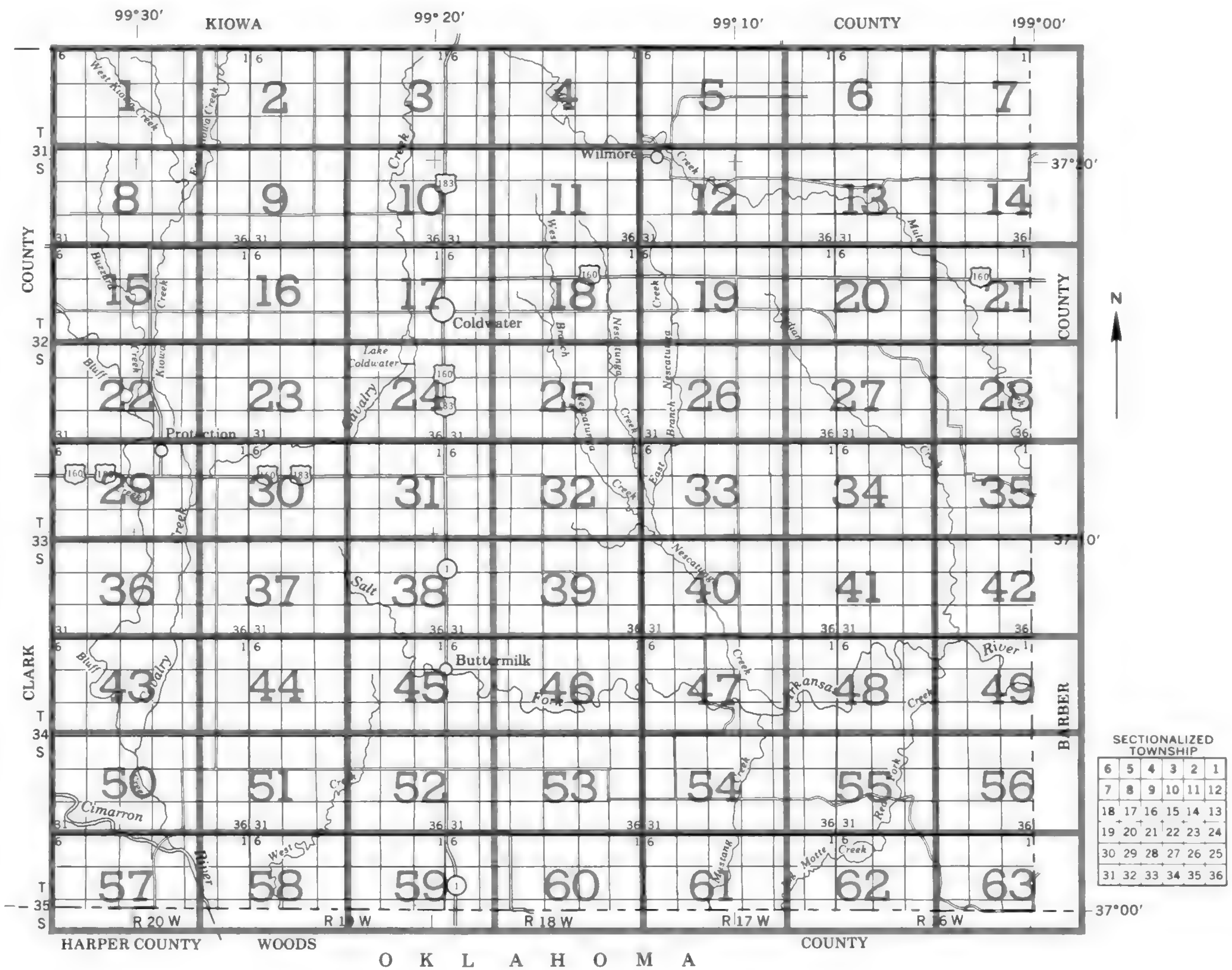
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
KANSAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
COMANCHE COUNTY, KANSAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km



INDEX TO MAP SHEETS
COMANCHE COUNTY, KANSAS

Scale 1:253,440

1 0 1 2 3 4 Miles

1 0 4 8 Km

SOIL LEGEND

SYMBOL	NAME
Ab	Abilene silt loam, 0 to 1 percent slopes
Ac	Abilene silt loam, 1 to 3 percent slopes
An	Albion sandy loam, 1 to 4 percent slopes
As	Albion-Shellabarger sandy loams, 4 to 15 percent slopes
Bt	Buttermilk silt loam
Ca	Canadian fine sandy loam
Cc	Carey silt loam, 0 to 2 percent slopes
Cd	Carey silt loam, 2 to 5 percent slopes
Ch	Case clay loam, 1 to 3 percent slopes
Ck	Case clay loam, 3 to 7 percent slopes
Cm	Case clay loam, 7 to 15 percent slopes
Co	Clairemont silt loam, occasionally flooded
Cp	Clairemont loam, channeled
Cr	Clark clay loam, 0 to 1 percent slopes
Cs	Clark clay loam, 1 to 3 percent slopes
Ct	Clark clay loam, 3 to 6 percent slopes
Cw	Clark-Kingsdown complex, 5 to 12 percent slopes
Dc	Dale silt loam
Ed	Elandco silt loam, occasionally flooded
Ef	Elandco silt loam, channeled
Fe	Farnum loam, 0 to 1 percent slopes
Ff	Farnum loam, 1 to 3 percent slopes
He	Hedville-Rock outcrop complex, 8 to 30 percent slopes
Hr	Holdrege silt loam, 1 to 3 percent slopes
Kc	Kanza loamy fine sand, frequently flooded
Kf	Kaski loam
Kn	Kingsdown fine sandy loam, 0 to 2 percent slopes
Ko	Kingsdown fine sandy loam, 2 to 5 percent slopes
Kr	Krier loam
Ld	Lancaster-Hedville fine sandy loams, 4 to 12 percent slopes
Le	Lesho clay loam, occasionally flooded
Ln	Lincoln loamy sand, occasionally flooded
Lo	Lincoln sandy loam, occasionally flooded
Lr	Lincoln-Krier complex, occasionally flooded
Oa	Obaro silty clay loam, 5 to 12 percent slopes
Ob	Obaro-Rock outcrop complex, 10 to 30 percent slopes
Oc	Ost clay loam, 2 to 6 percent slopes
Ph	Port silt loam, occasionally flooded
Po	Pratt loamy fine sand, rolling
Pr	Pratt loamy fine sand, undulating
Pt	Pratt-Tivoli loamy fine sands, rolling
Qr	Quinlan-Woodward loams, 6 to 15 percent slopes
Qt	Quinlan-Woodward loams, 15 to 30 percent slopes
Sb	St. Paul silt loam, 0 to 1 percent slopes
Sc	St. Paul silt loam, 1 to 3 percent slopes
Sg	Shellabarger sandy loam, 0 to 1 percent slopes
Sh	Shellabarger sandy loam, 1 to 3 percent slopes
Sm	Shellabarger sandy loam, 3 to 6 percent slopes
Tv	Tivoli fine sand, hilly
Wd	Waldeck fine sandy loam, occasionally flooded
We	Westview silt loam, 0 to 1 percent slopes
Wf	Wellsford clay, 6 to 25 percent slopes
Wo	Woodward loam, 1 to 3 percent slopes
Ws	Woodward-Quinlan loams, 3 to 6 percent slopes
Ye	Yahola fine sandy loam, occasionally flooded
Ze	Zenda clay loam, occasionally flooded

CONVENTIONAL AND SPECIAL SYMBOLS LEGEND

CULTURAL FEATURES

BOUNDARIES

- National, state or province
- County or parish
- Minor civil division
- Reservation (national forest or park, state forest or park, and large airport)
- Land grant
- Limit of soil survey (label)
- Field sheet matchline and neatline

AD HOC BOUNDARY (label)

- Small airport, airfield, park, oilfield, cemetery, or flood pool

STATE COORDINATE TICK

LAND DIVISION CORNER (sections and land grants)

ROADS

- Divided (median shown if scale permits)
- Other roads
- Trail

ROAD EMBLEM & DESIGNATIONS

- Interstate
- Federal
- State
- County, farm or ranch

RAILROAD

POWER TRANSMISSION LINE (normally not shown)

PIPE LINE (normally not shown)

FENCE (normally not shown)

LEVEES

- Without road
- With road
- With railroad

DAMS

- Large (to scale)
- Medium or Small

PITS

- Gravel pit
- Mine or quarry

MISCELLANEOUS CULTURAL FEATURES

- Farmstead, house (omit in urban areas)
- Church
- School
- Indian mound (label)
- Located object (label)
- Tank (label)
- Wells, oil or gas
- Windmill
- Kitchen midden

WATER FEATURES

DRAINAGE

- Perennial, double line
- Perennial, single line
- Intermittent
- Drainage end
- Canals or ditches
  - Double-line (label)
  - Drainage and/or irrigation

LAKES, PONDS AND RESERVOIRS

- Perennial
- Intermittent

MISCELLANEOUS WATER FEATURES

- Marsh or swamp
- Spring
- Well, artesian
- Well, irrigation
- Wet spot

SPECIAL SYMBOLS FOR SOIL SURVEY

SOIL DELINEATIONS AND SYMBOLS

ESCARPMENTS

- Bedrock (points down slope)
- Other than bedrock (points down slope)

SHORT STEEP SLOPE

GULLY

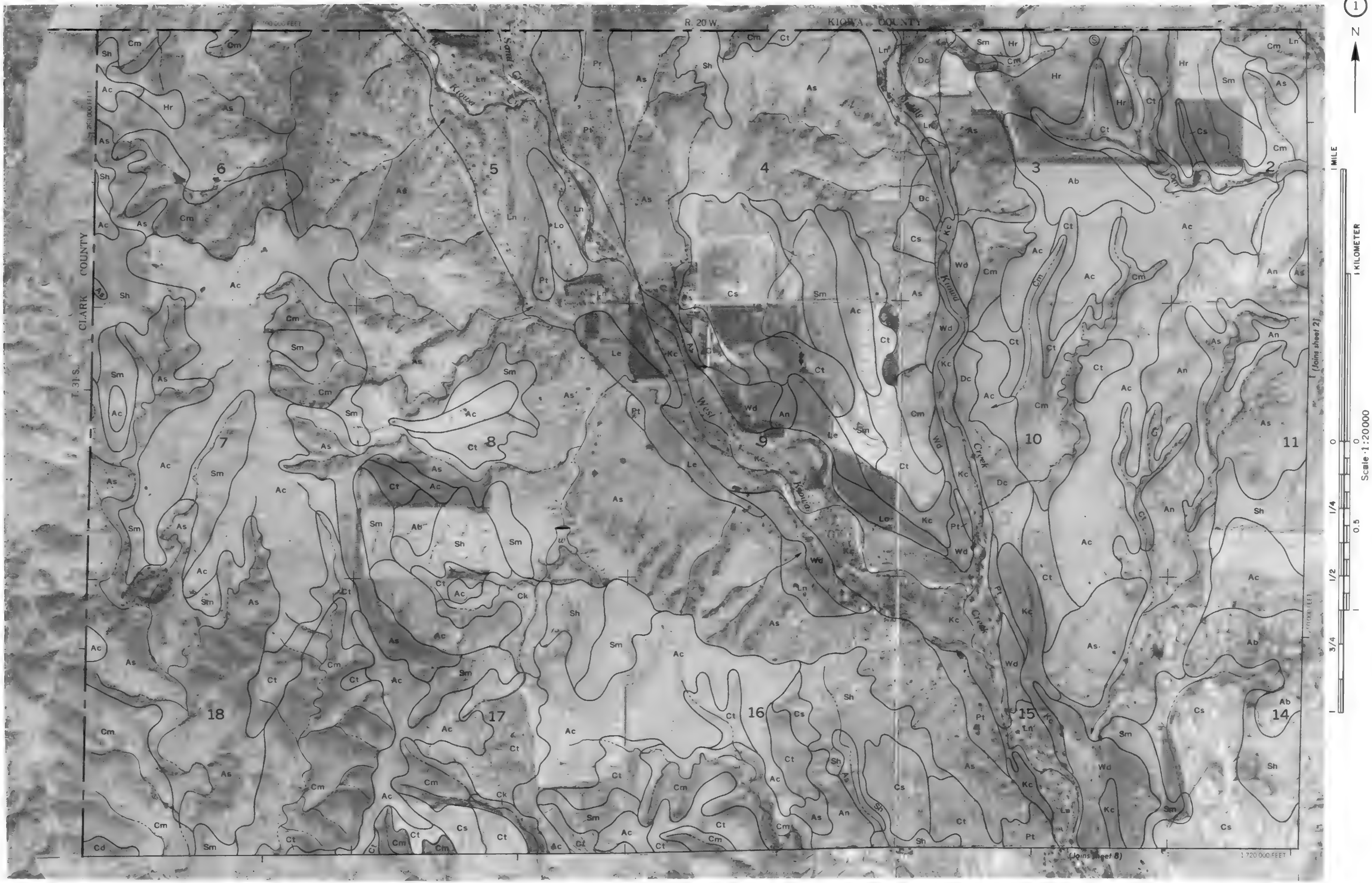
DEPRESSION OR SINK

SOIL SAMPLE (normally not shown)

MISCELLANEOUS

- Blowout
- Clay spot
- Gravelly spot
- Gumbo, slick or scabby spot (sodic)
- Dumps and other similar non soil areas
- Prominent hill or peak
- Rock outcrop (includes sandstone and shale)
- Saline spot
- Sandy spot
- Severely eroded spot
- Slide or slip (tips point upslope)
- Stony spot, very stony spot

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 1

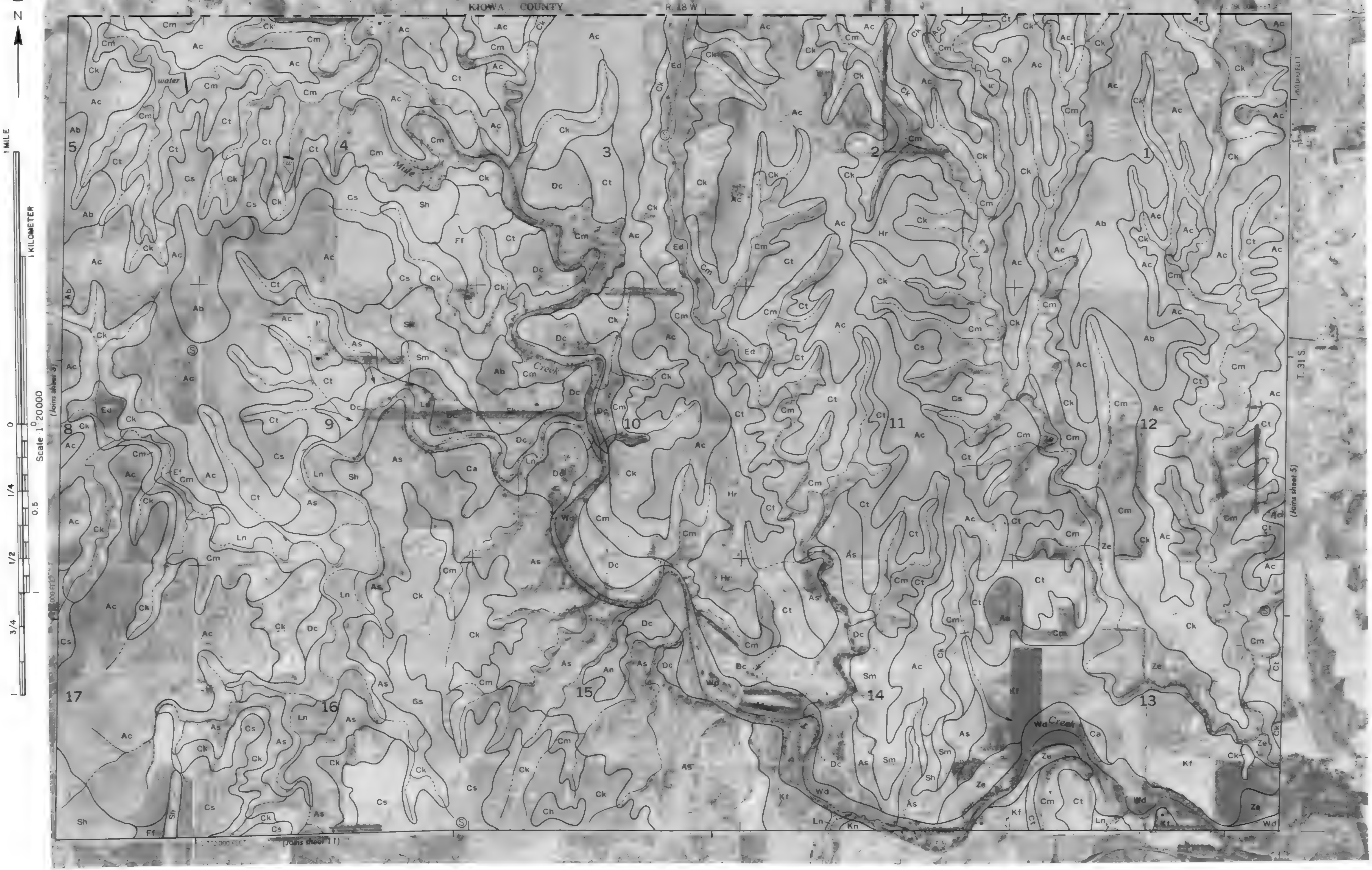


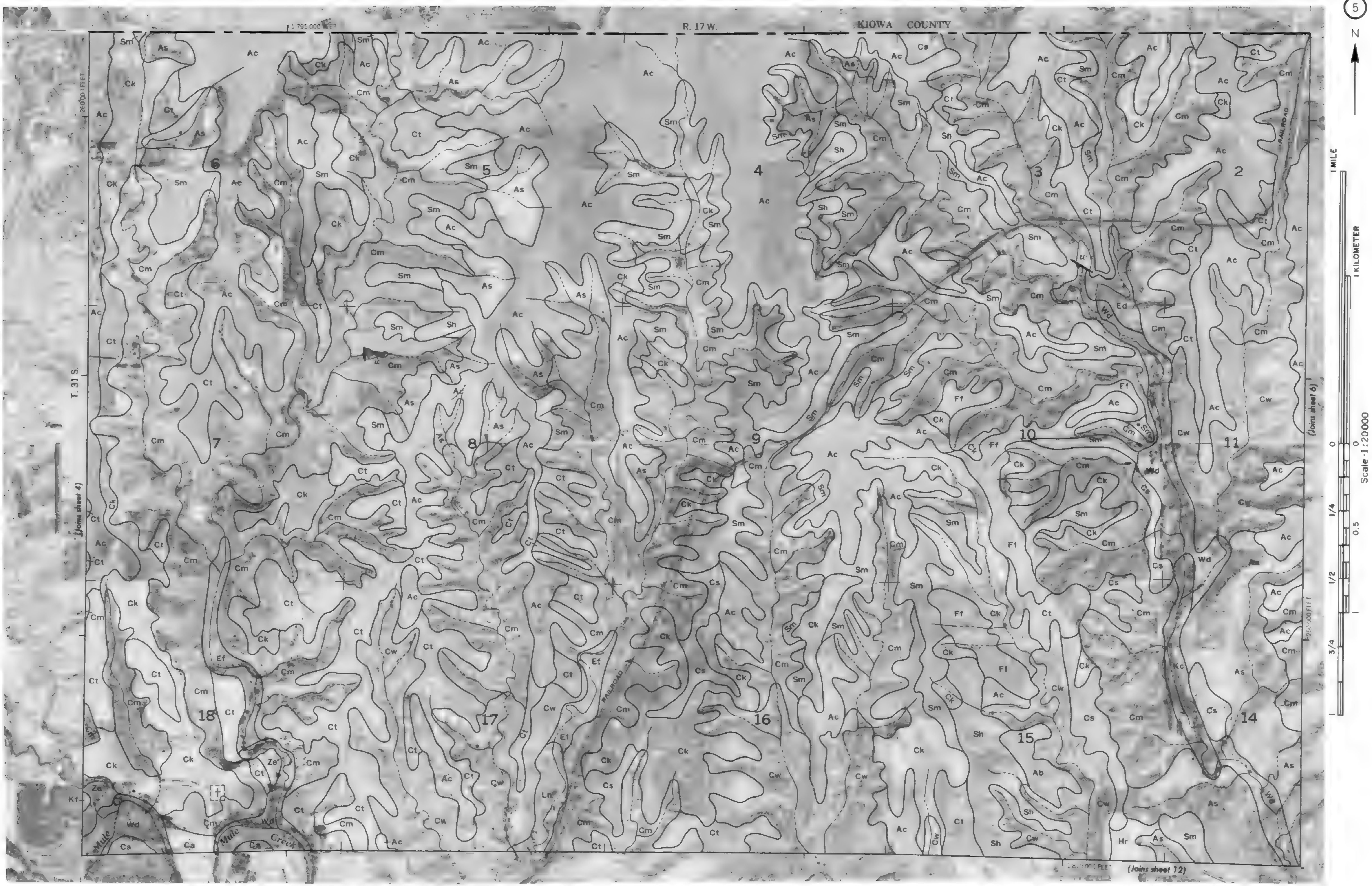
SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 2

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 3

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 4

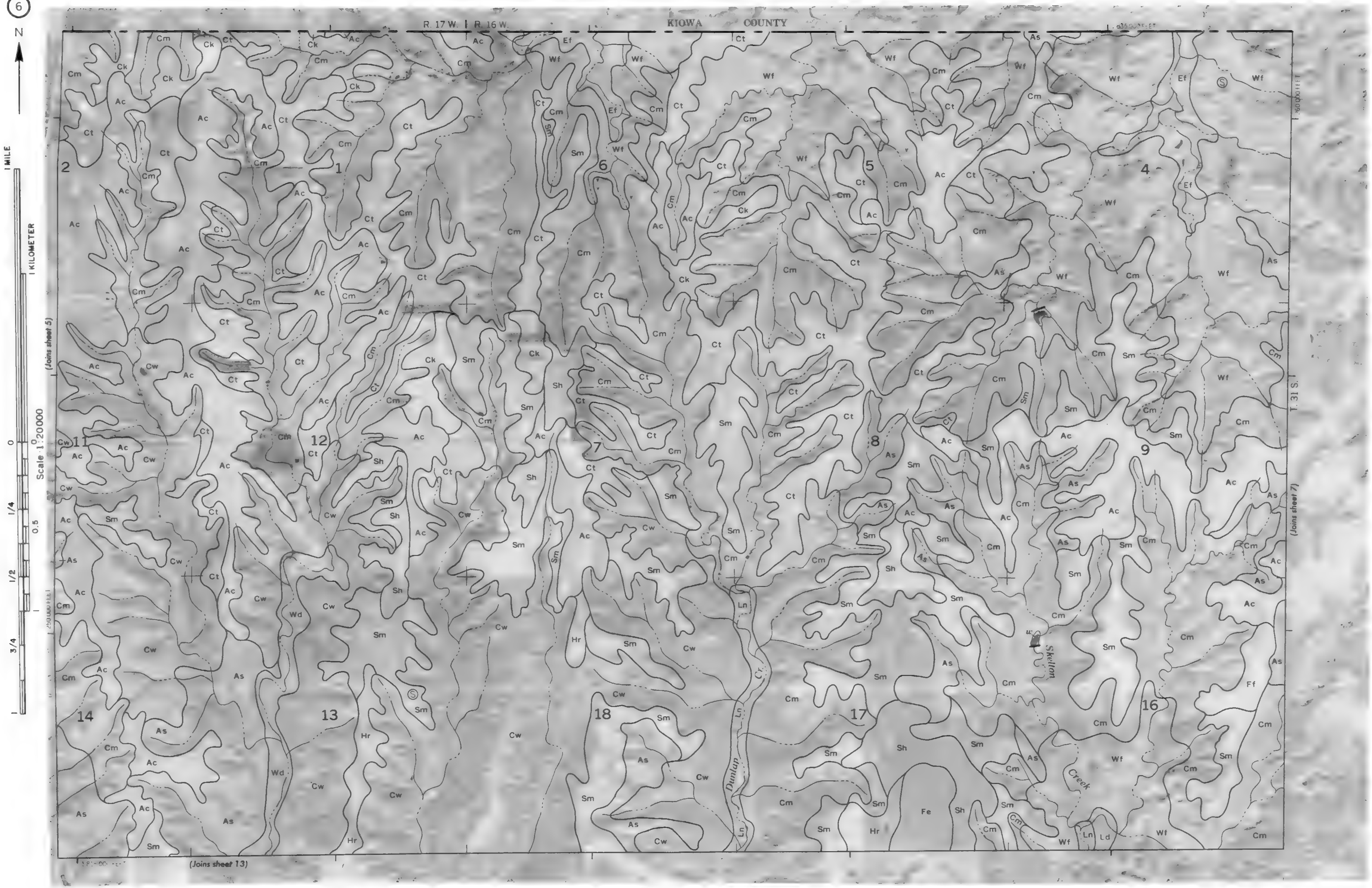
4



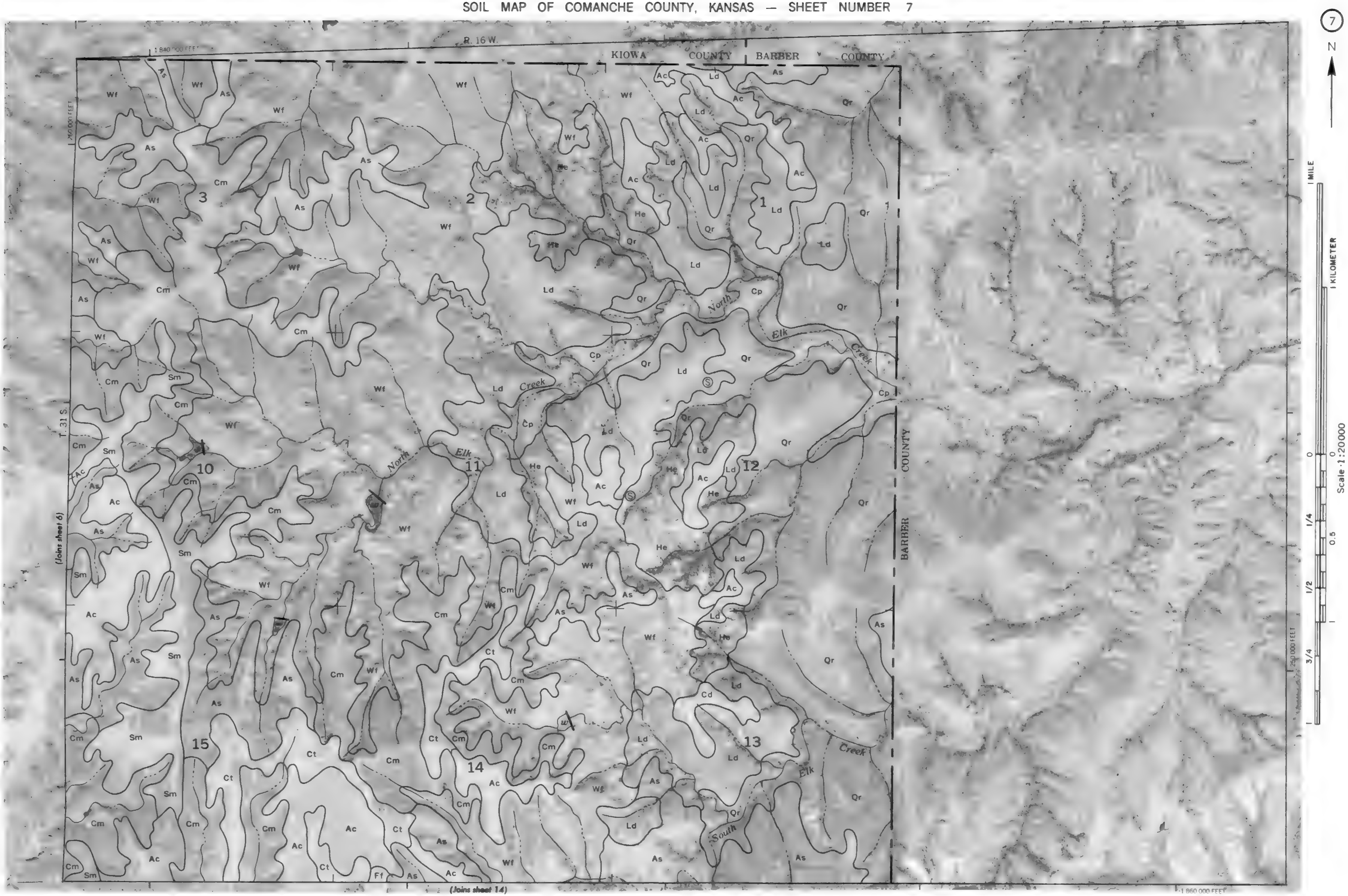

5
N
KIOWA COUNTY
R. 17 W.
1 795 000 FEET
260 000 FEET
T. 31 S.
(Joins sheet 4)
(Joins sheet 6)
(Joins sheet 12)
18 000 FEET
250 000 FEET
RAILROAD
Mule Creek
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

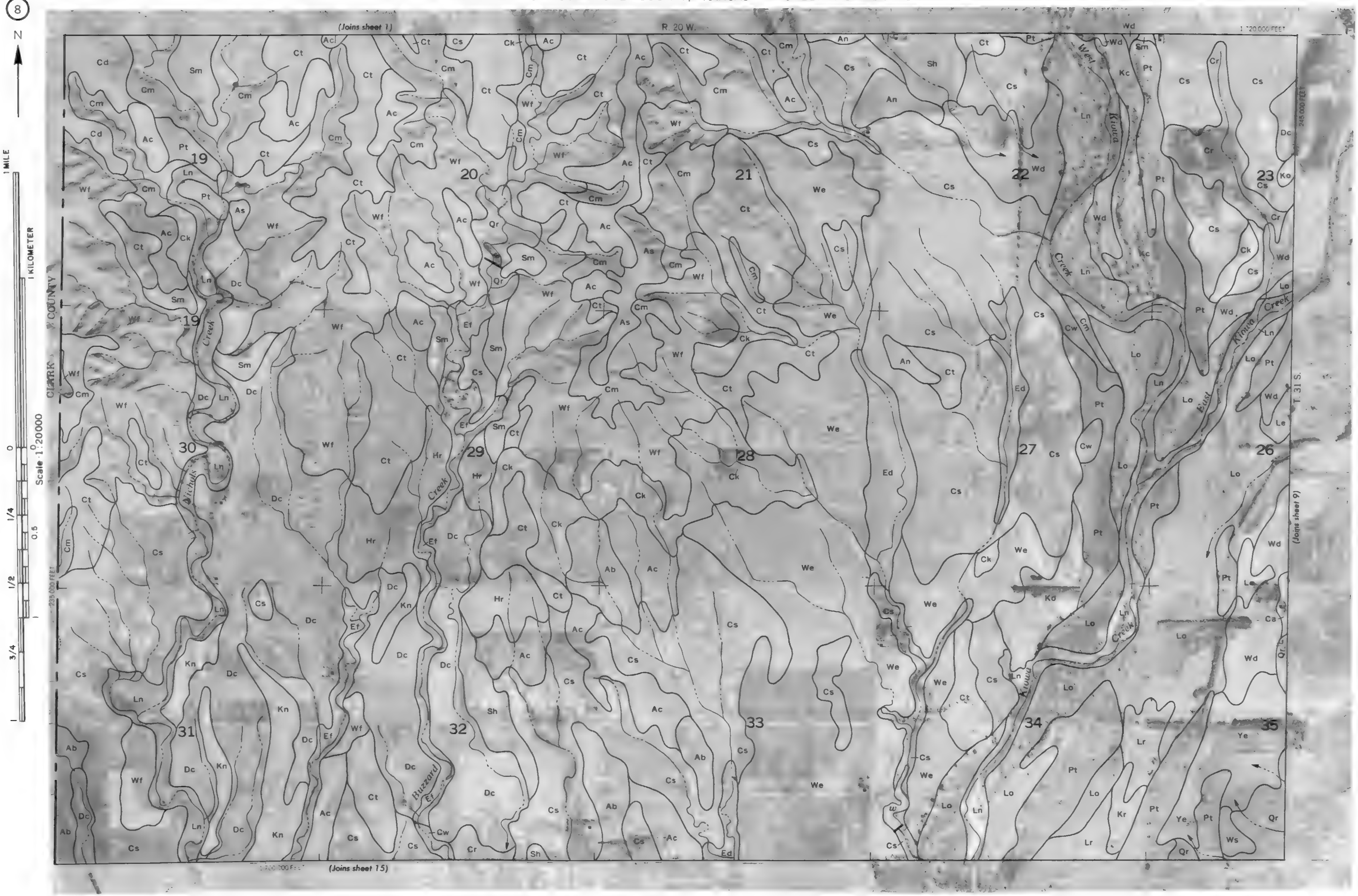
(6)

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 6

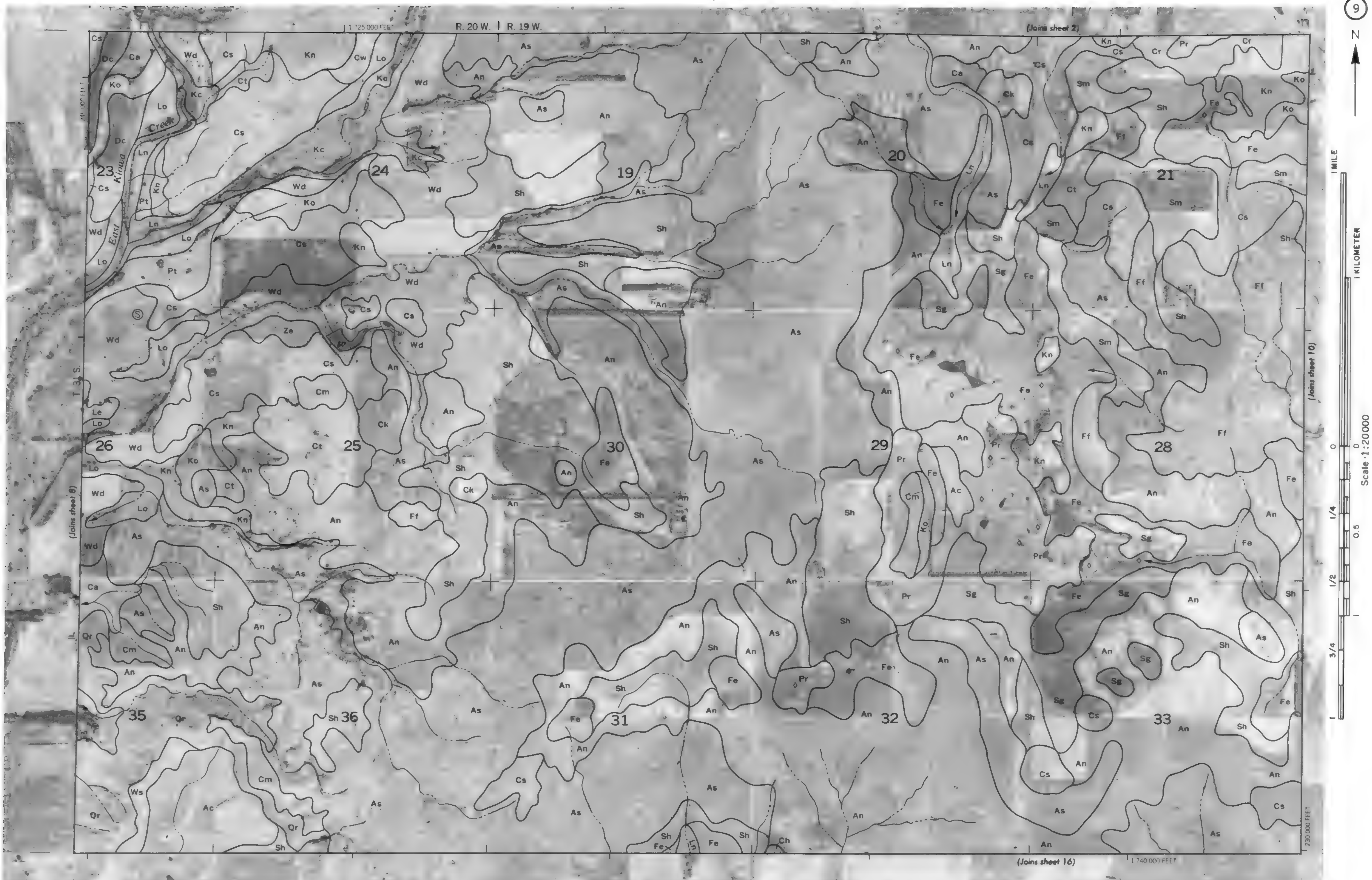


SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 7



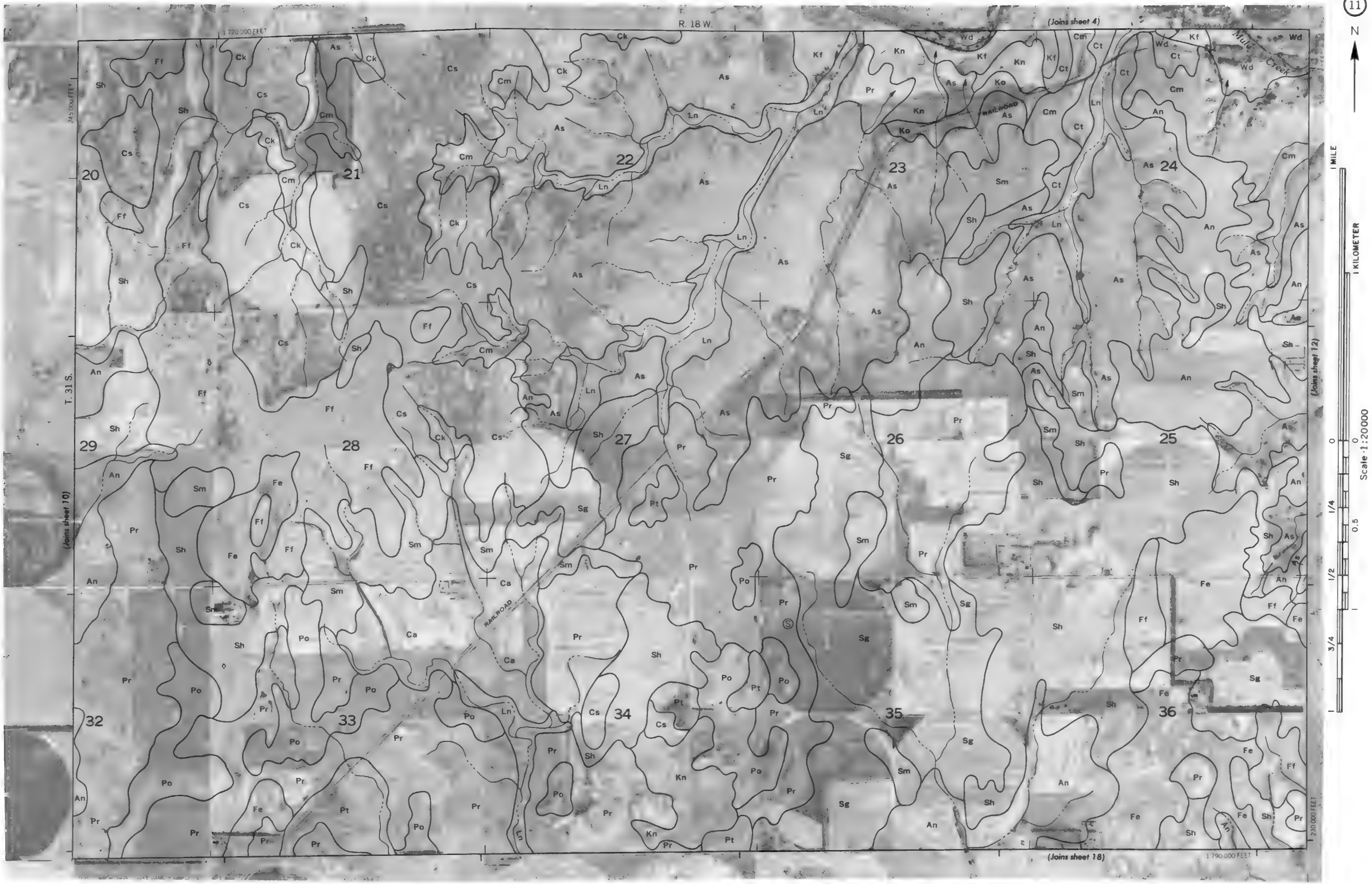

8
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
(Joins sheet 1)
R. 20 W.
(Joins sheet 9)
(Joins sheet 15)
T. 31 S.
CLARK COUNTY
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35
Mulberry Creek
Wichita Creek
Buzzard Creek
West Kiowa Creek
East Kiowa Creek
Kiowa Creek

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 9

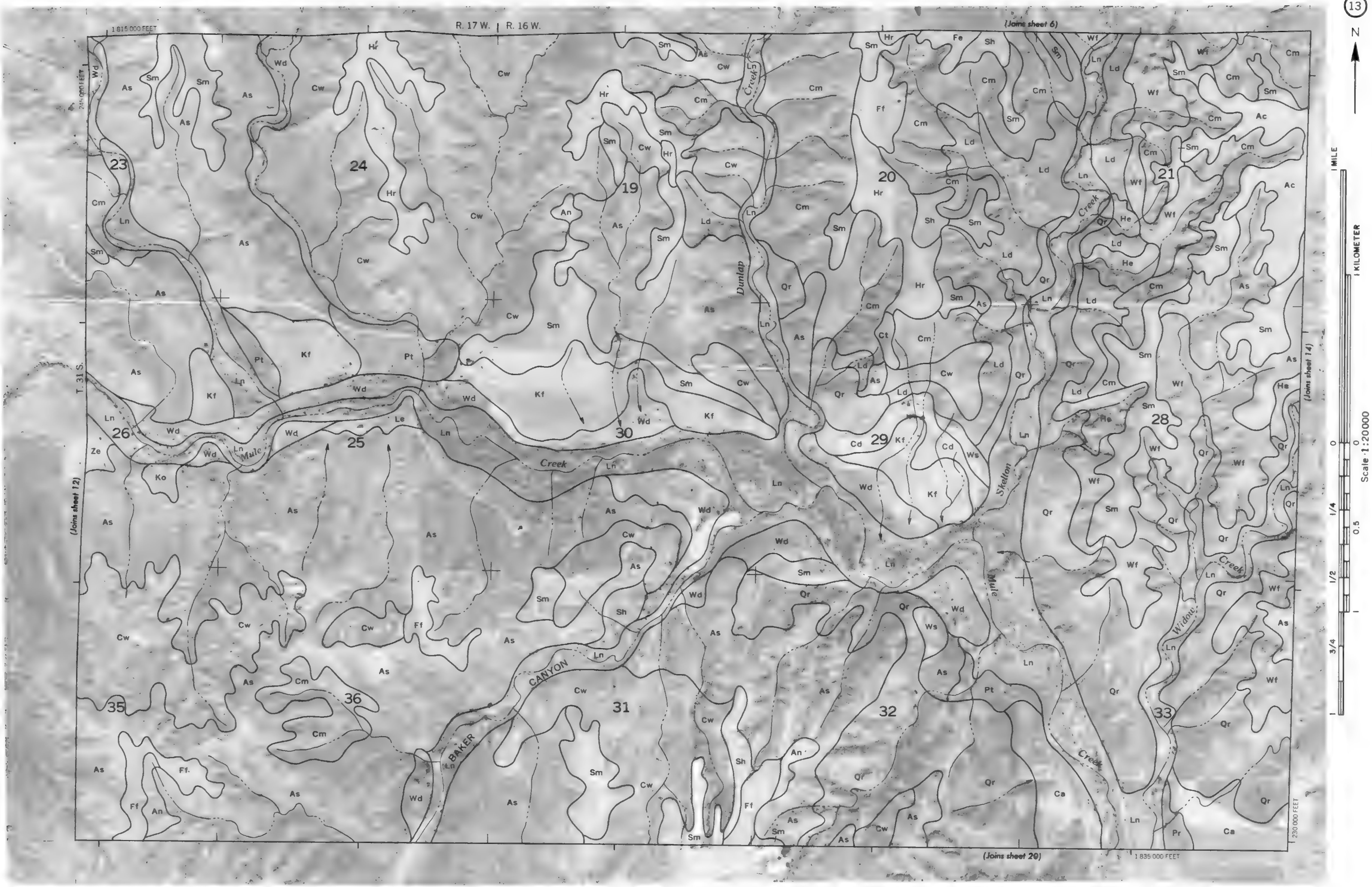


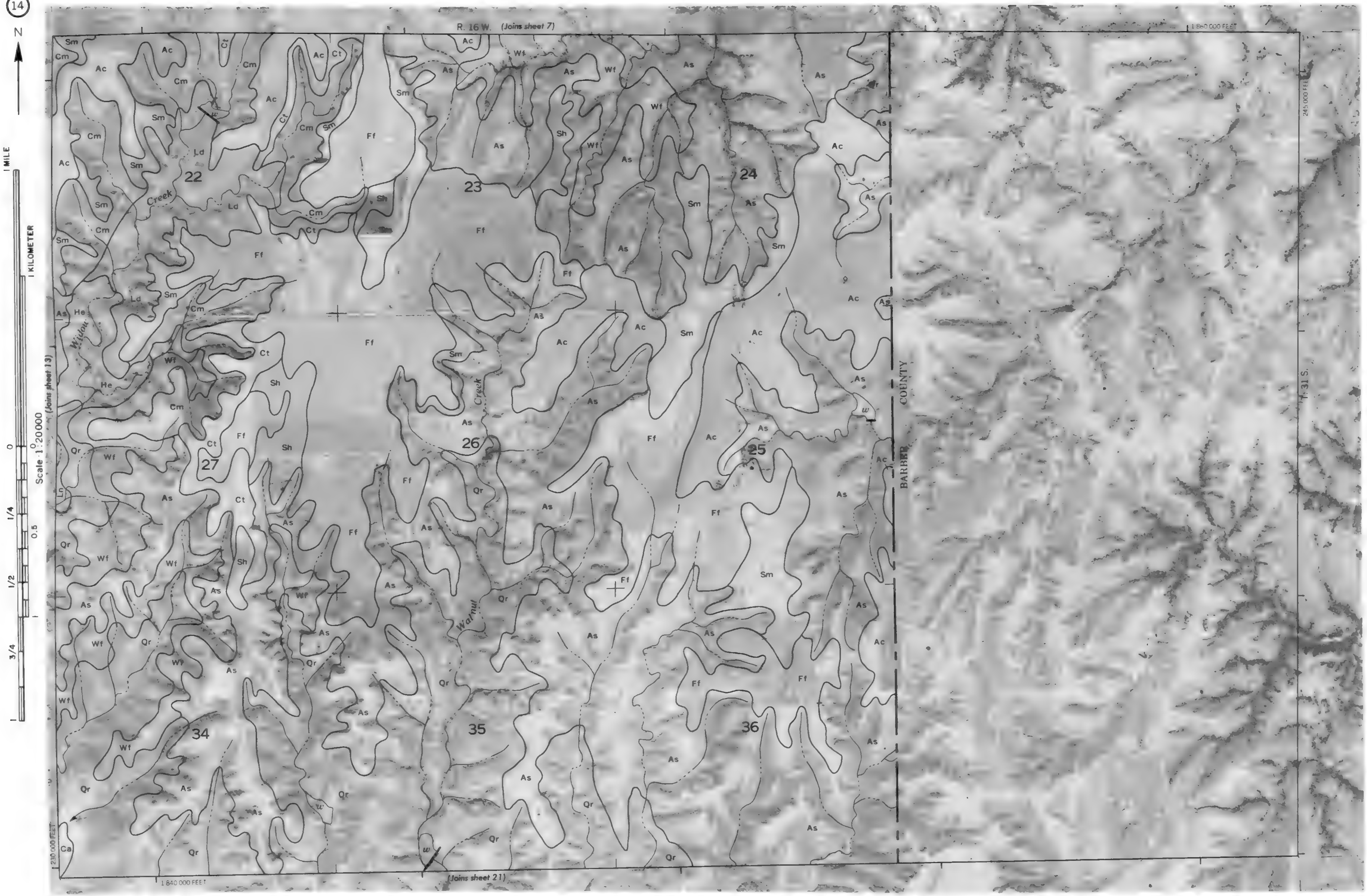
SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 10

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 11



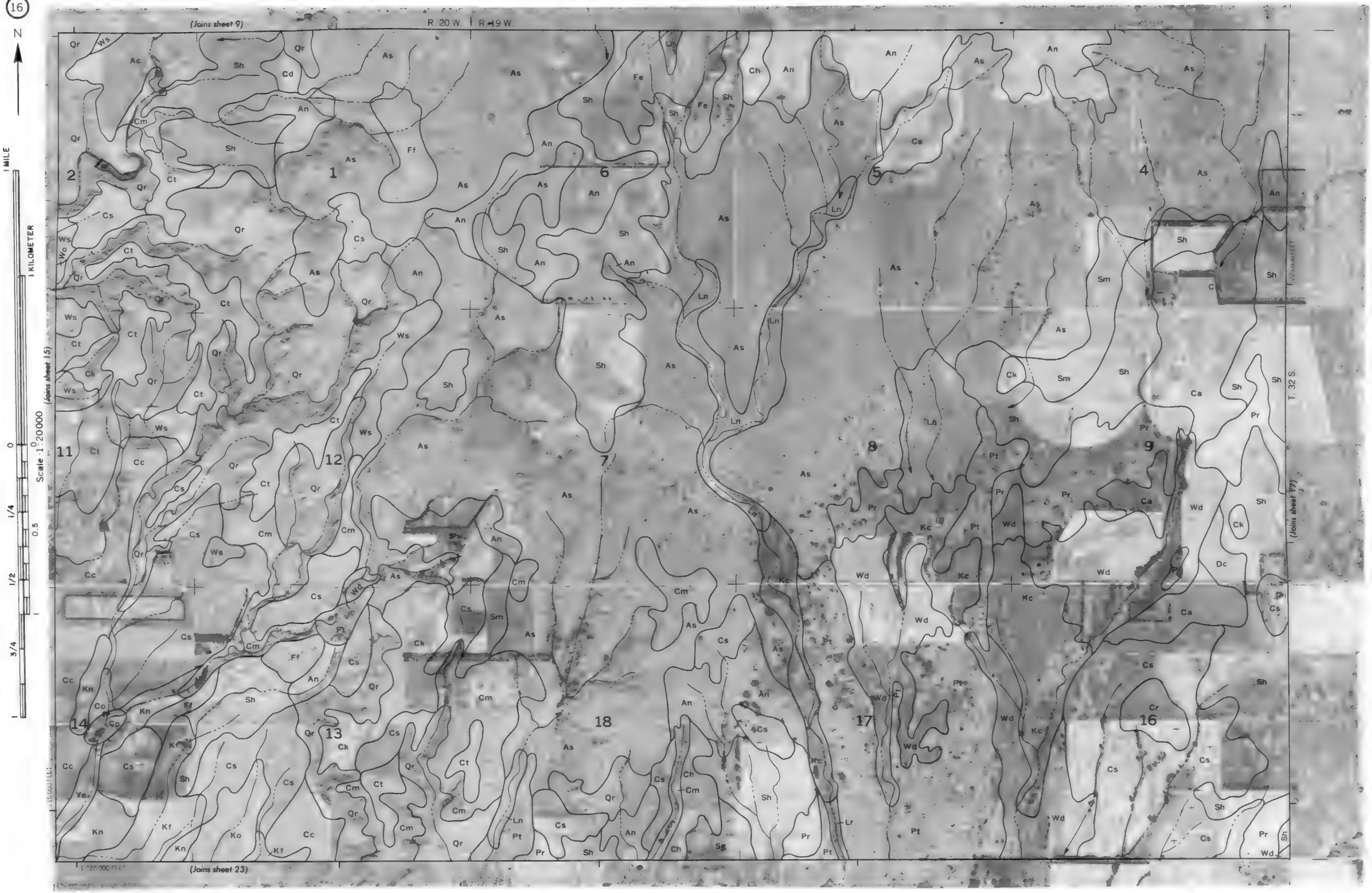

N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 5)
R. 17 W.
1 810 000 FEET
Wilmore
RAILROAD
Mule
Creek
(Joins sheet 11)
(Joins sheet 13)
T. 31 S.
(Joins sheet 19)
1 795 000 FEET
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35


1 815 000 FEET
R. 17 W.
R. 16 W.
(Joins sheet 6)
(Joins sheet 12)
(Joins sheet 14)
(Joins sheet 20)
T. 31 S.
1 835 000 FEET
230 000 FEET
Mule Creek
Dunlap Creek
Skelton
Mule
Widow Creek
Creek
BAKER CANYON
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5


N
R. 16 W. (Joins sheet 7)
(Joins sheet 13)
(Joins sheet 21)
BARBER COUNTY
T. 31 S.
Scale 1:20000
1 MILE
1 KILOMETER
0
1/4
1/2
3/4
1
0.5
1 840 000 FEET
230 000 FEET
245 000 FEET
22
23
24
25
26
27
34
35
36
Widow Creek
Creek
Walnut Creek
Sm
Cm
Ac
Ct
Ld
Ff
Sh
As
Wf
He
Qr
Fd
Ca

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 15

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 16



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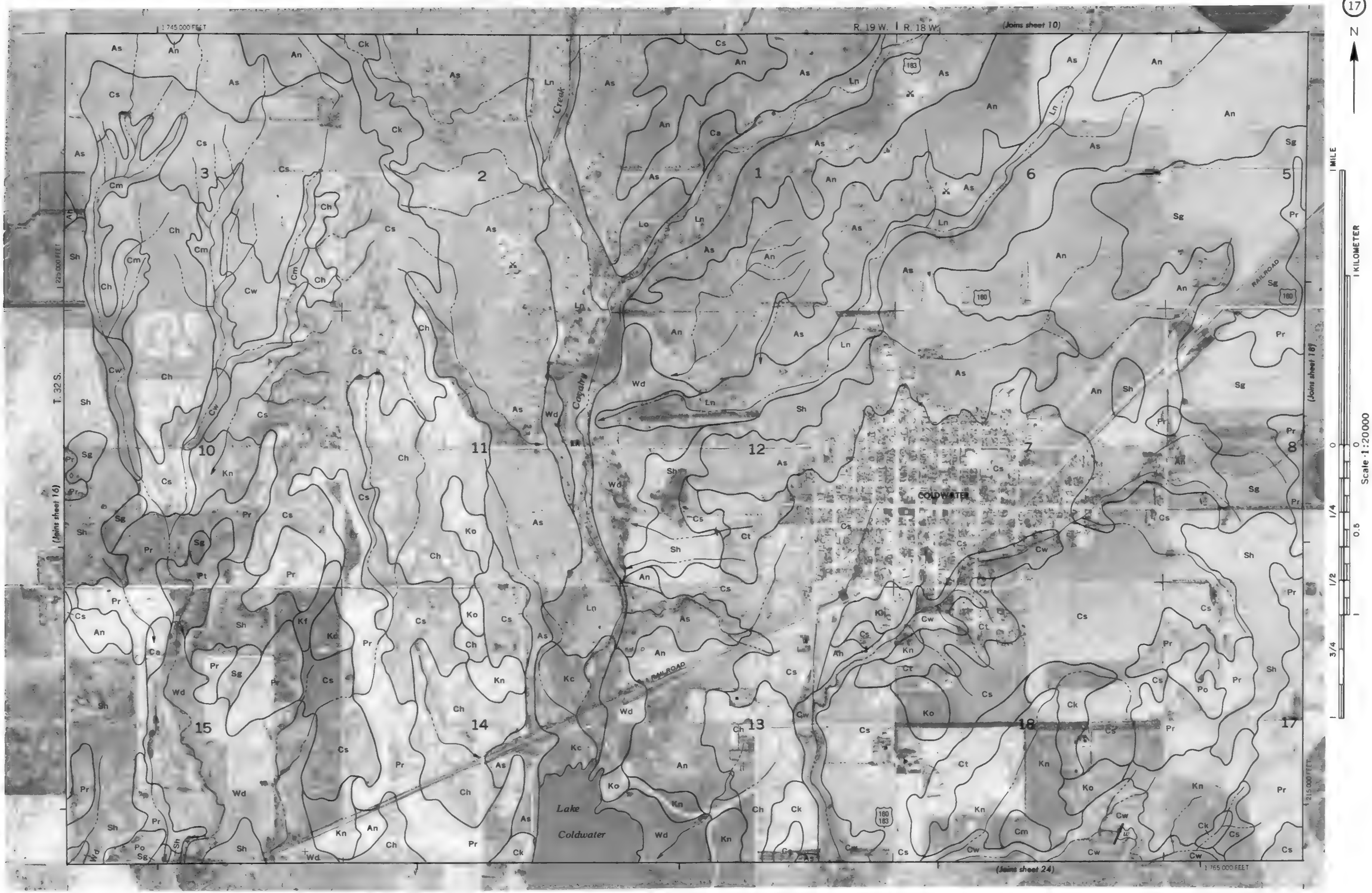

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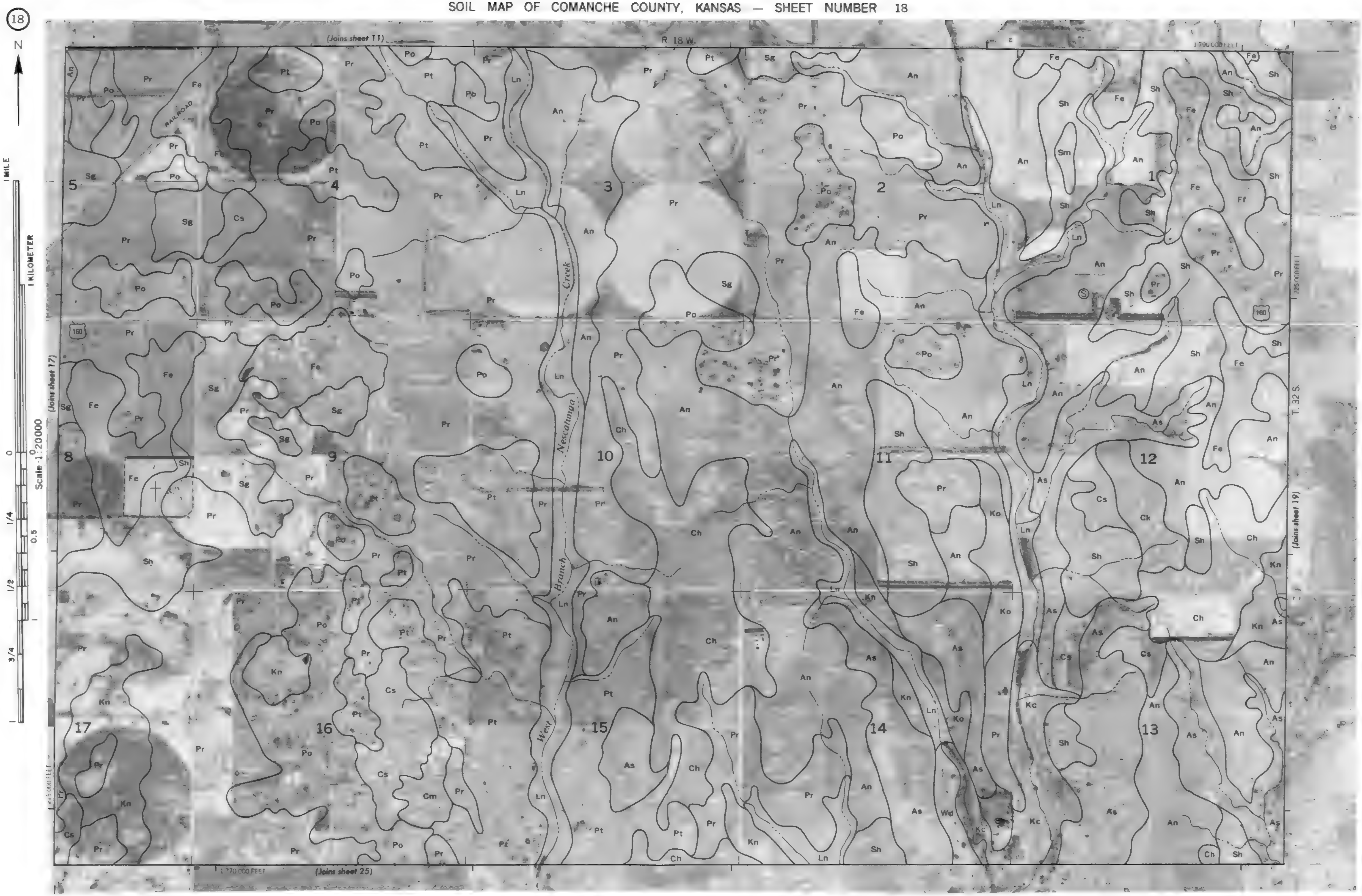

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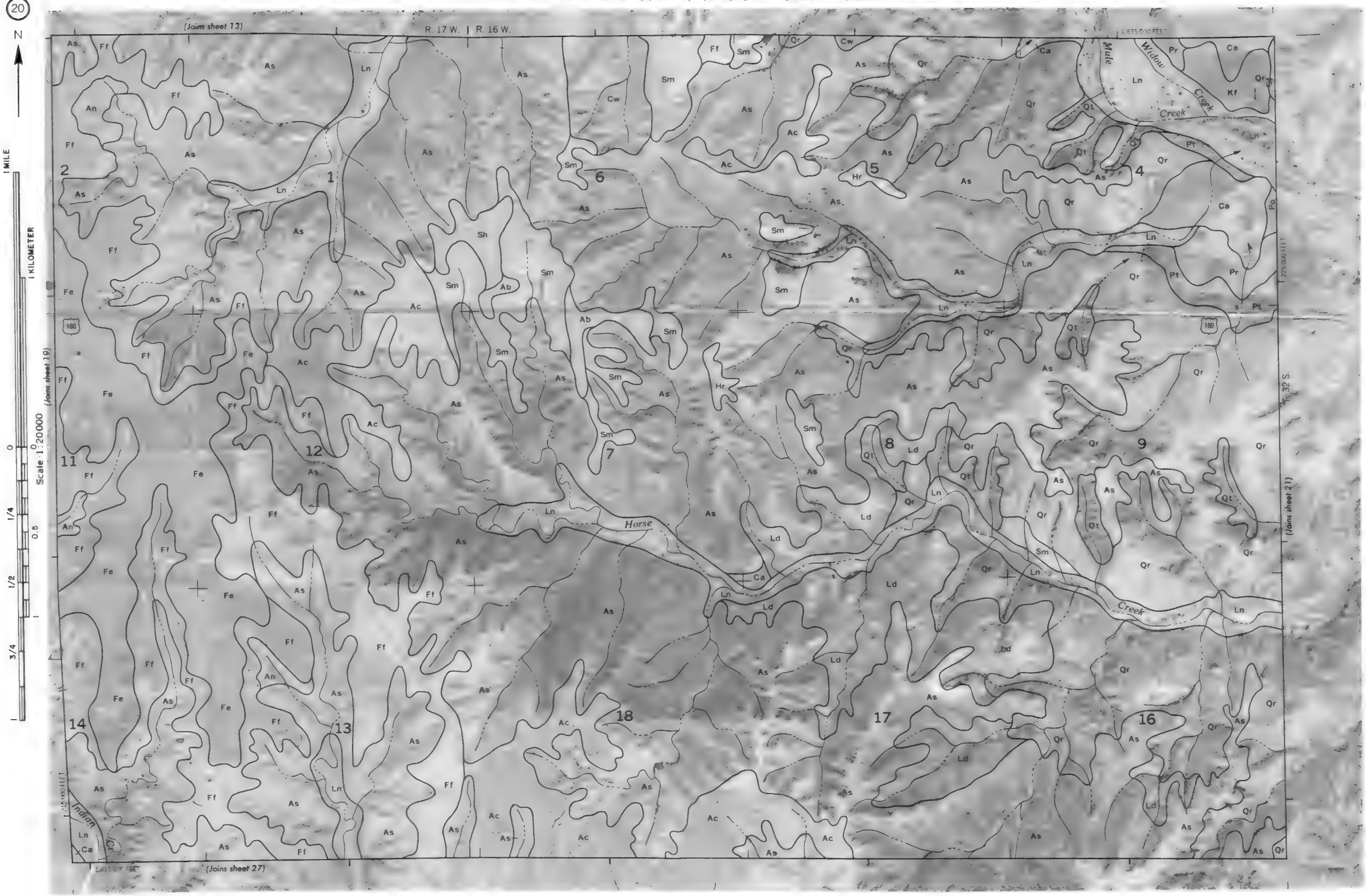
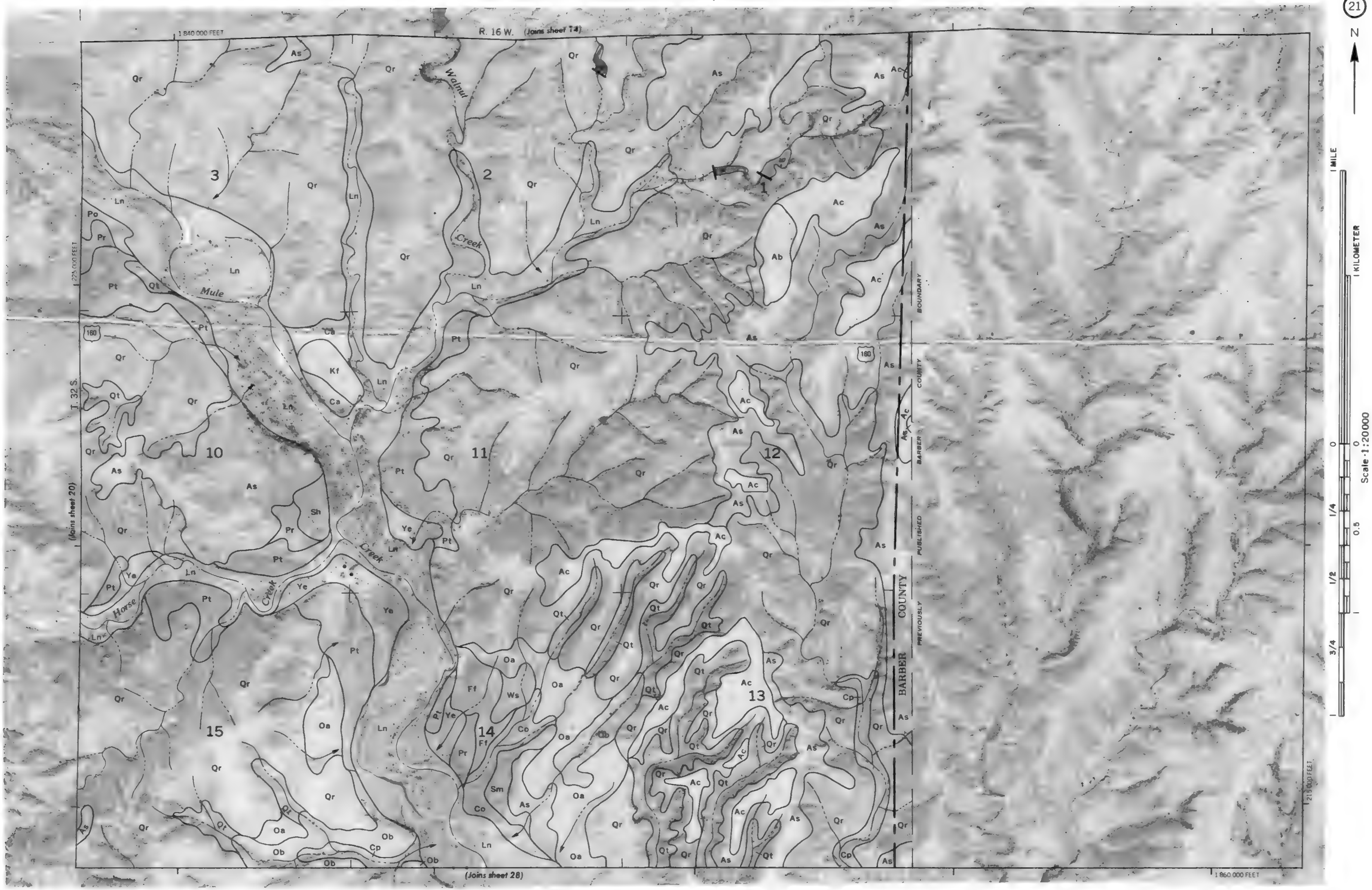
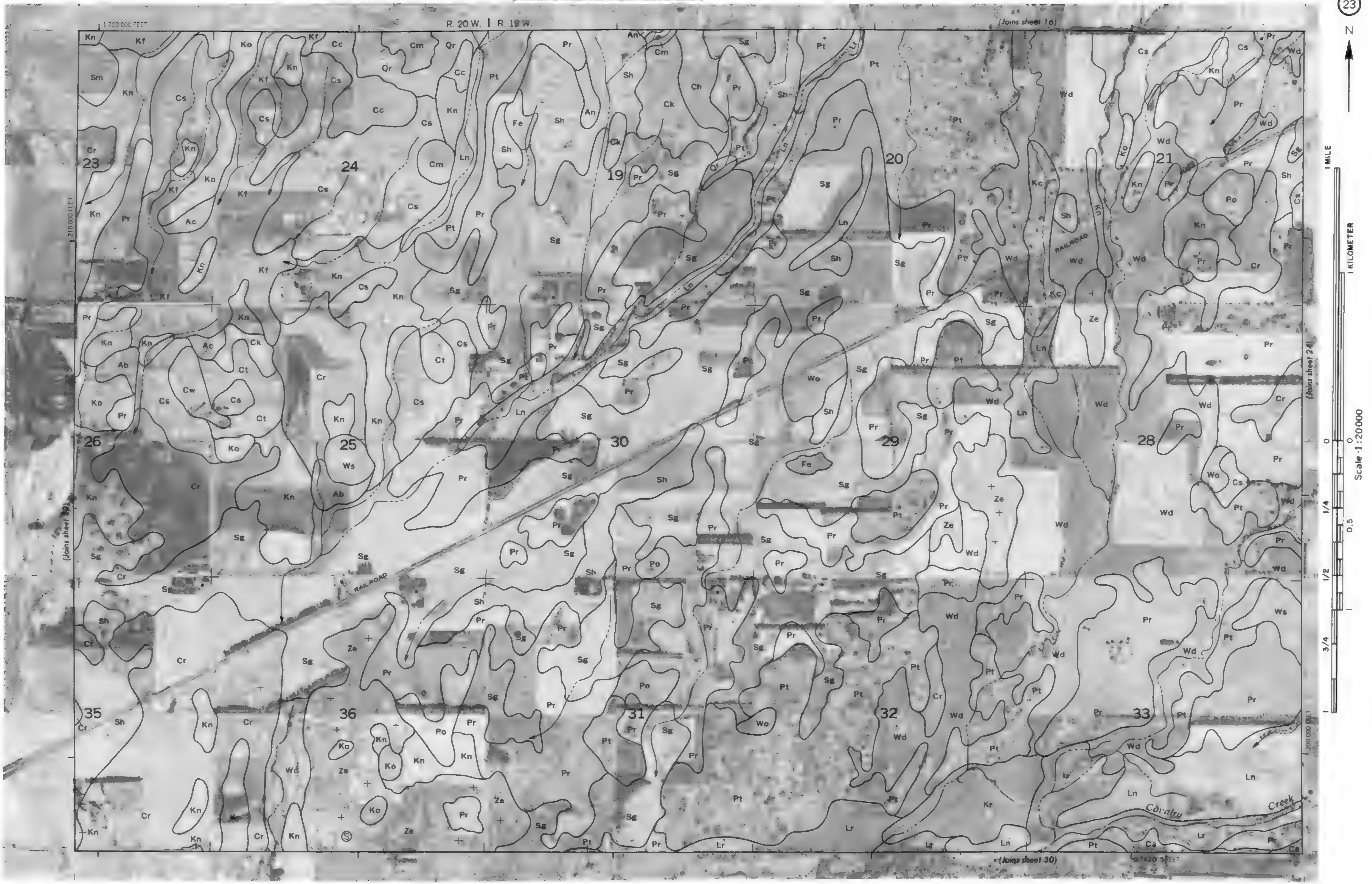

20
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
(Joins sheet 13)
R. 17 W. | R. 16 W.
(Joins sheet 19)
(Joins sheet 21)
(Joins sheet 27)
T. 32 S.
160
Horse Creek
Mule Creek
Widow Creek
Indian Cr.

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 21




22
N
(Joins sheet 15)
R. 20 W.
1 715 000 FEET
(Joins sheet 29)
700 000 FEET
(Joins sheet 23)
T. 32 S.
CLARK COUNTY
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
Bluff
Creek
Buzzard
Creek
Kiowa
Creek
RAILROAD
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 23



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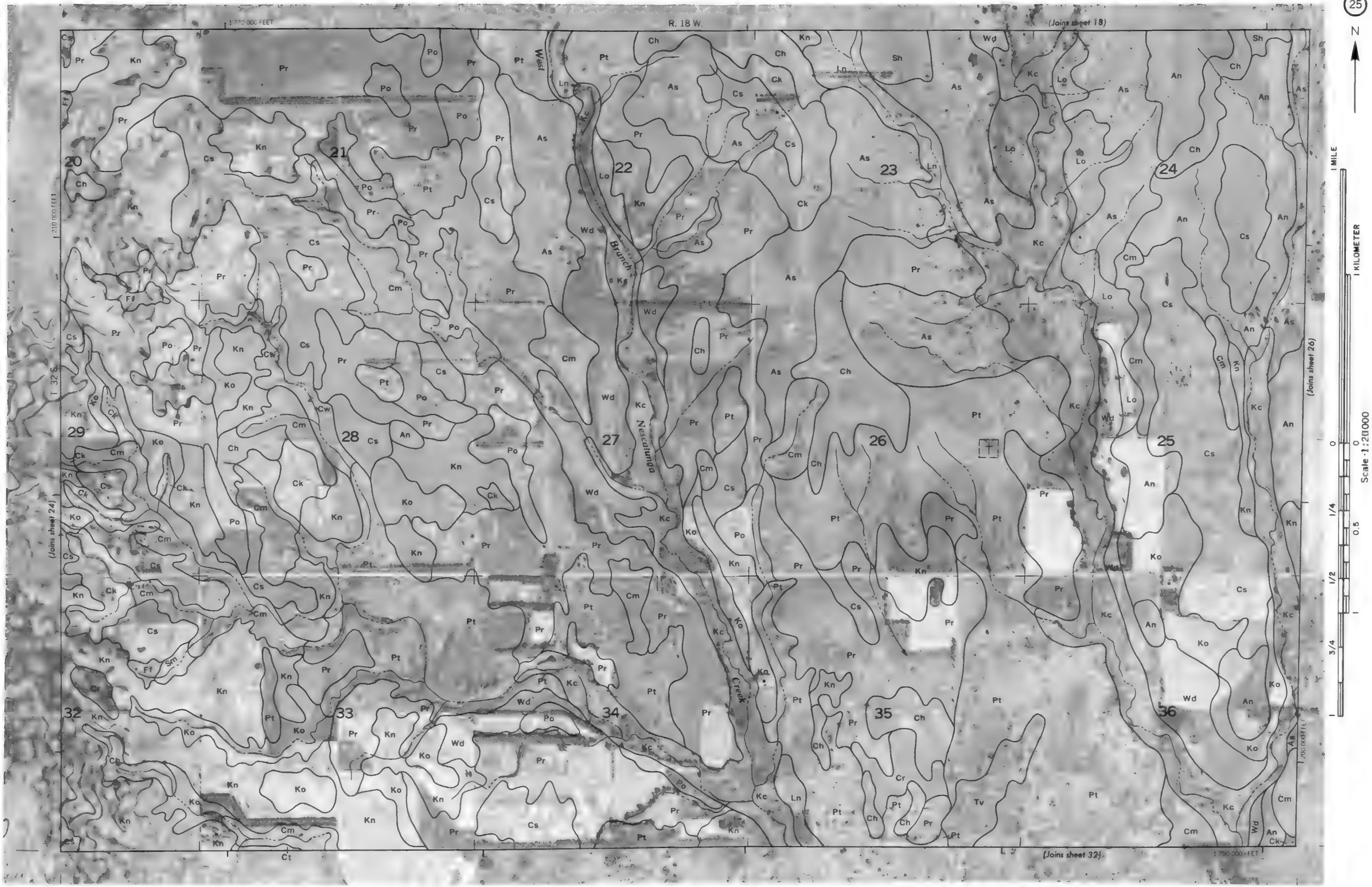
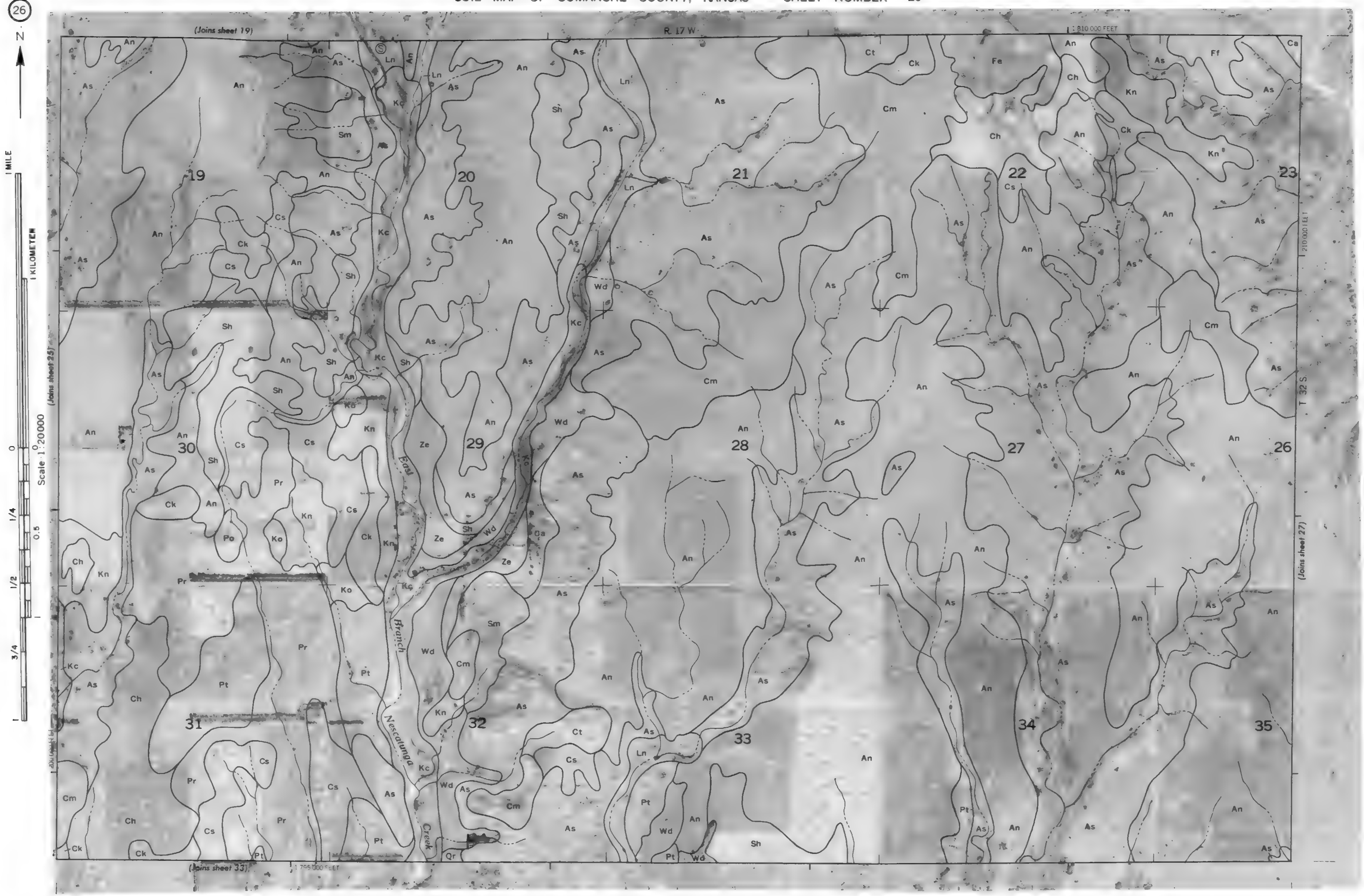
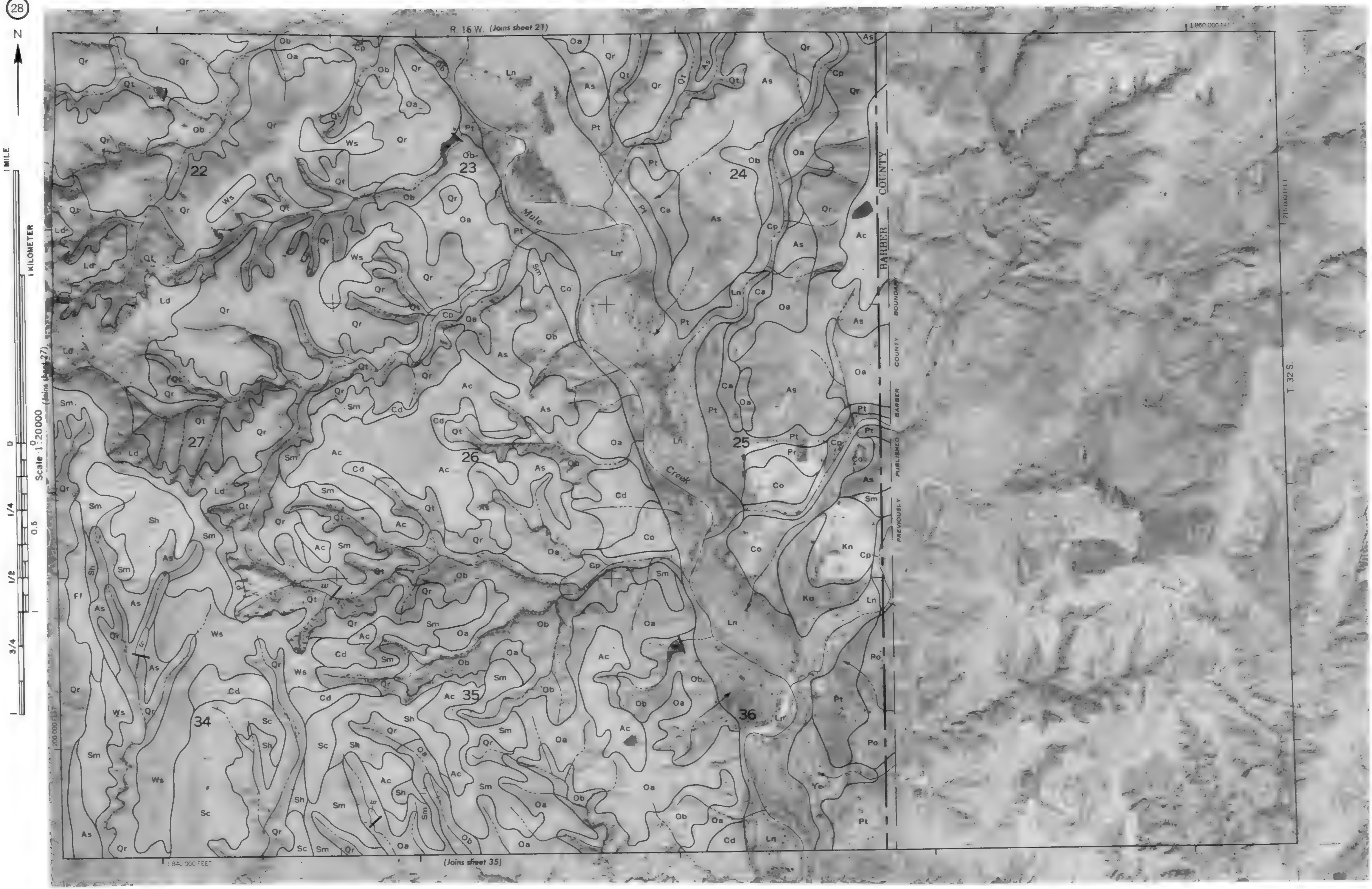

25
N
R. 18 W.
(Joins sheet 18)
(Joins sheet 26)
(Joins sheet 24)
(Joins sheet 32)
T. 32 S.
1 770 000 FEET
1 790 000 FEET
210 000 FEET
200 000 FEET
West Branch
Nescatunga Creek
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

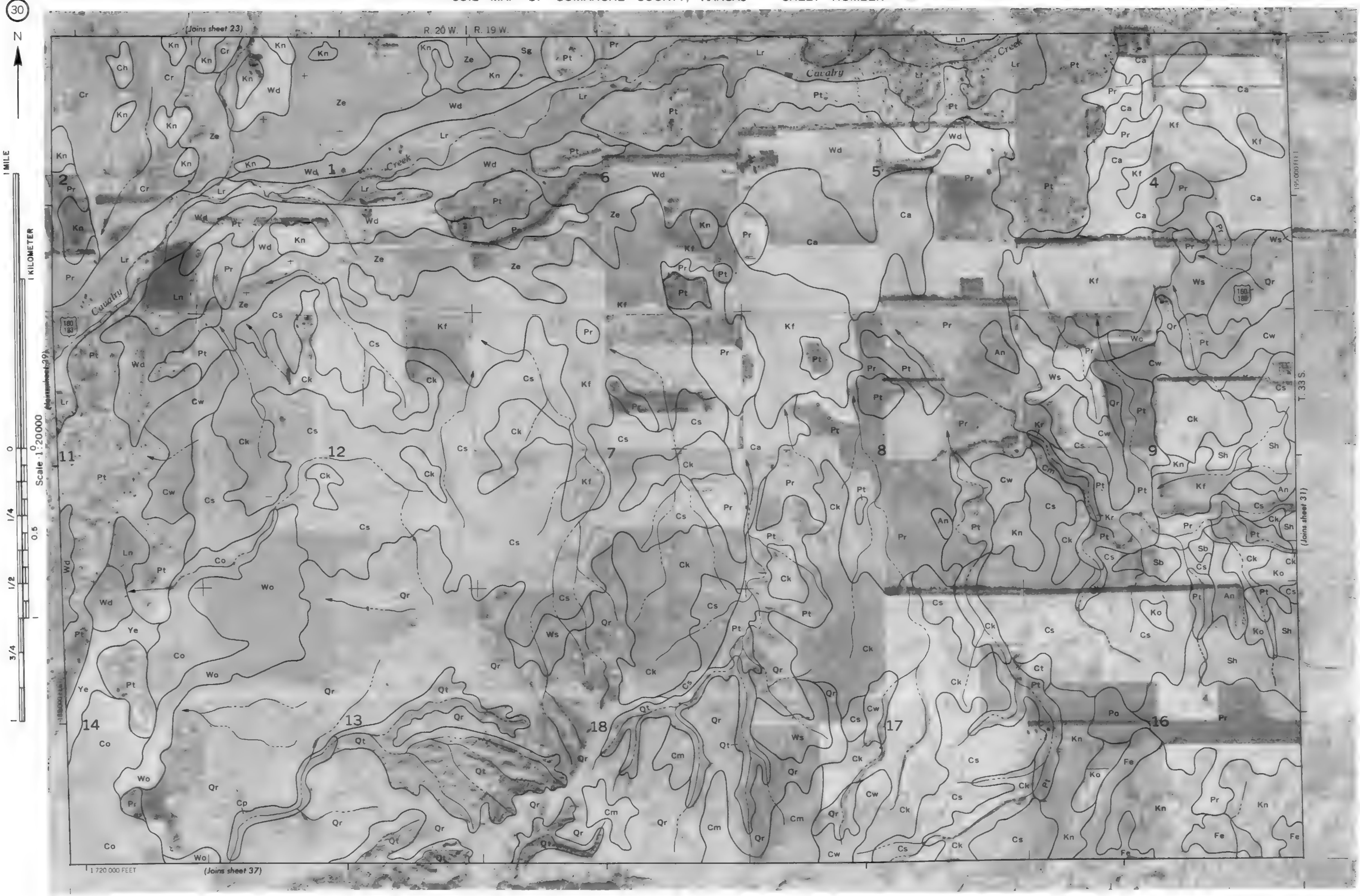

26
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
1
3/4
1
(Joins sheet 19)
R. 17 W.
1 810 000 FEET
(Joins sheet 25)
(Joins sheet 27)
T. 32 S.
210 000 FEET
(Joins sheet 33)
1 795 000 FEET
East
Branch
Nescatunga
Creek
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35


27
N
R. 17 W. | R. 16 W.
(Joins sheet 20)
(Joins sheet 26)
(Joins sheet 28)
(Joins sheet 34)
T. 32 S.
Indian Creek
Indian Creek
1 MILE
1 KILOMETER
Scale 1:20 000
0
1/4
1/2
3/4
1
0
0.5
1
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 28



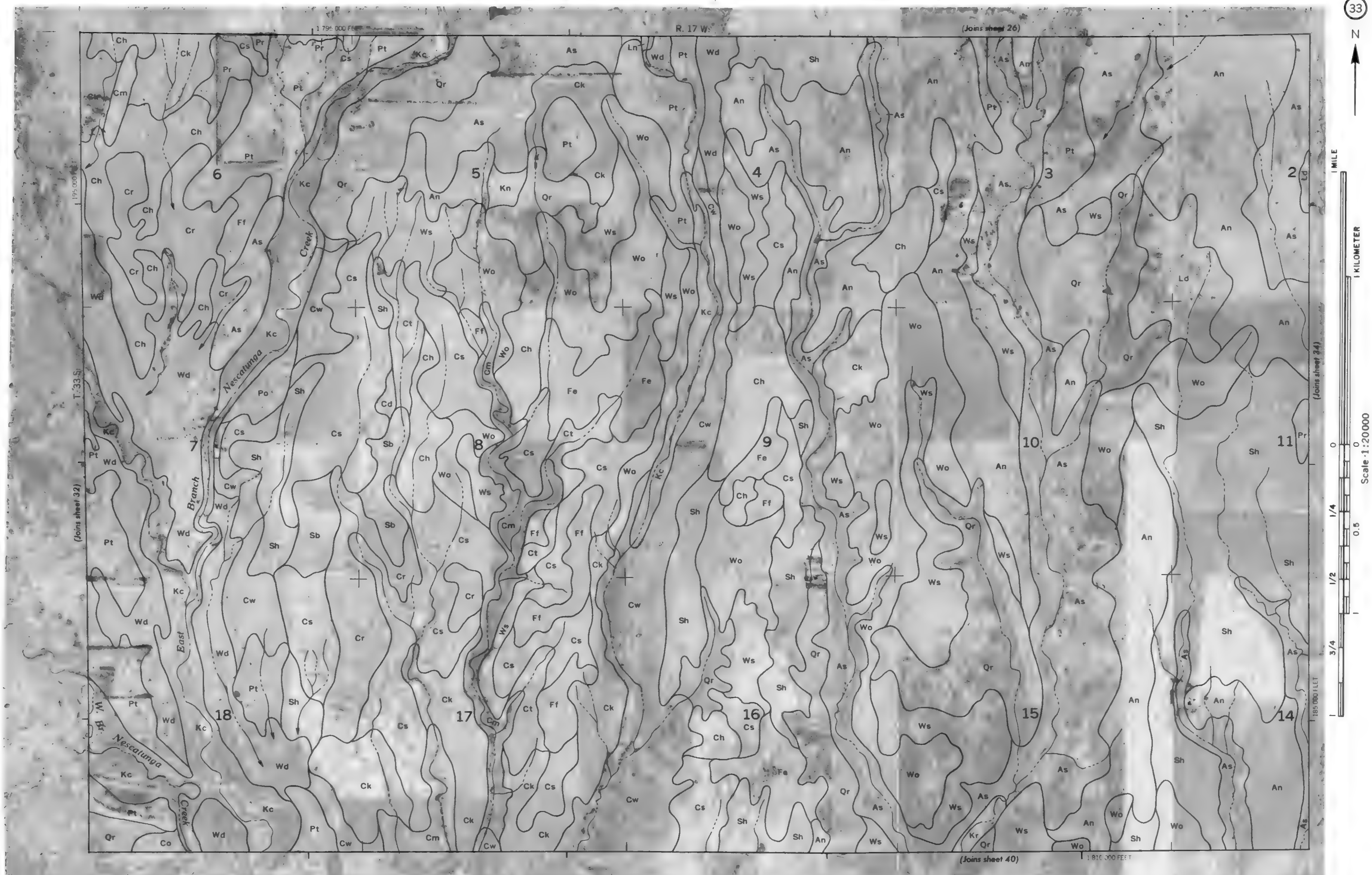

29
N
(Joins sheet 22)
(Joins sheet 30)
(Joins sheet 36)
R. 20 W.
T. 33 S.
CLARK COUNTY
1 790 000 FEET
195 000 FEET
185 000 FEET
1 715 000 FEET
Protection
RAILROAD
Bluff
Creek
Kiowa
Creek
Cavalry
Creek
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5


30
N
(Joins sheet 23)
R. 20 W. | R. 19 W.
Cavalry Creek
Creek
(Joins sheet 29)
(Joins sheet 31)
(Joins sheet 37)
T. 33 S.
1 720 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0
0.5
1
160
183


31
N
(Joins sheet 24)
R. 19 W. | R. 18 W.
1 245 000 FEET
195 000 FEET
T. 33 S.
(Joins sheet 30)
(Joins sheet 32)
(Joins sheet 38)
1 765 000 FEET
185 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 32

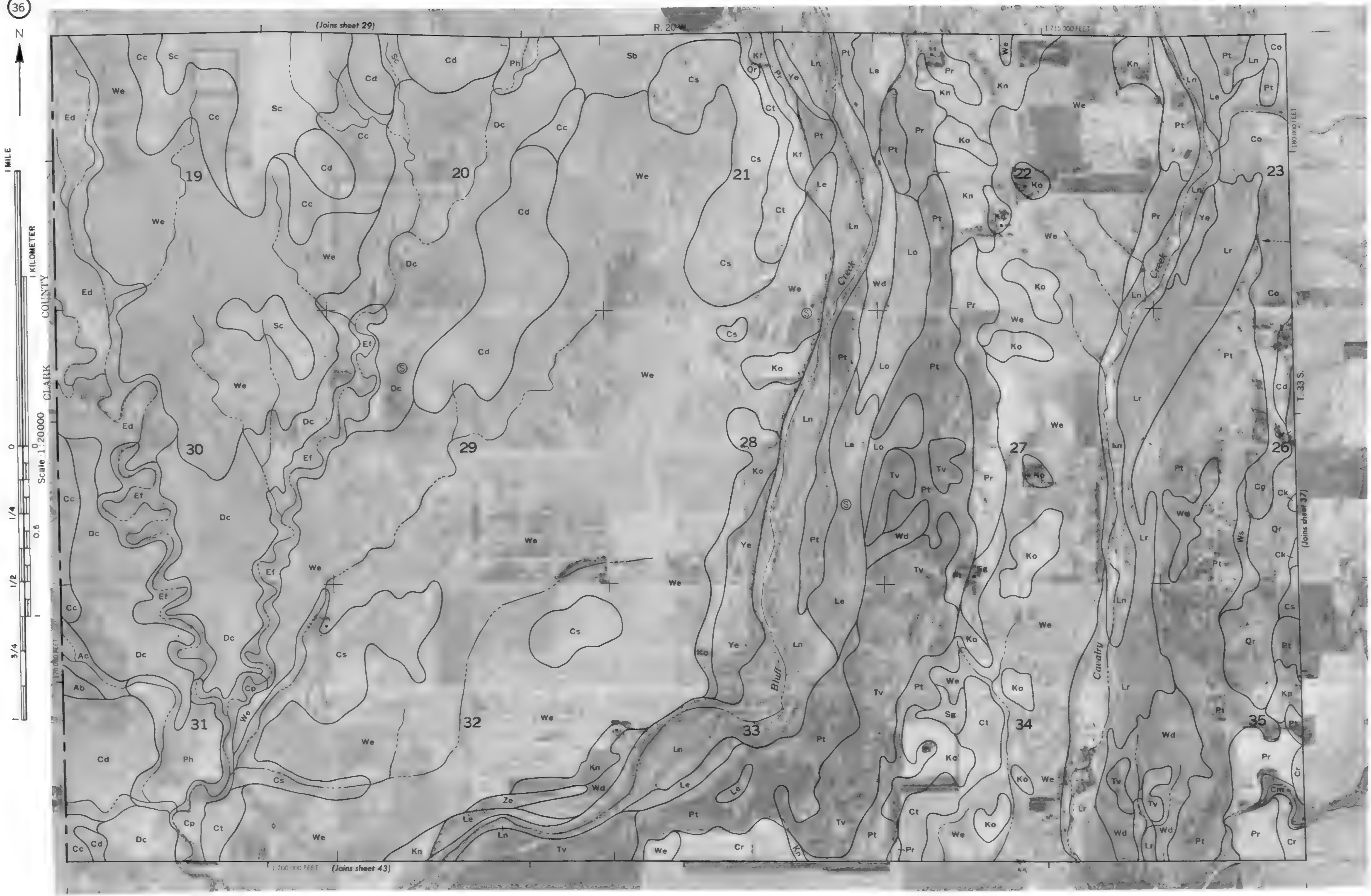
SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 33

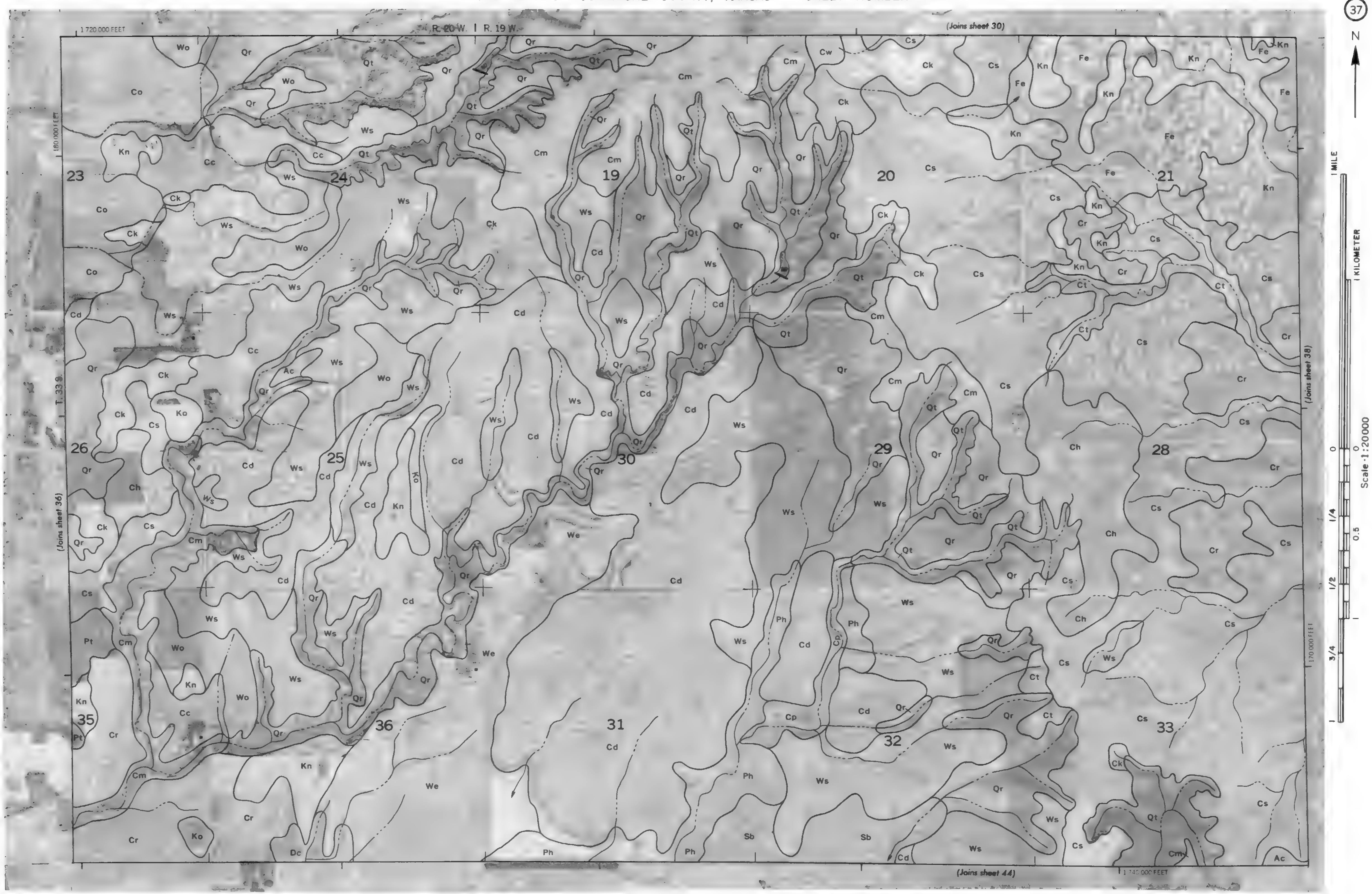


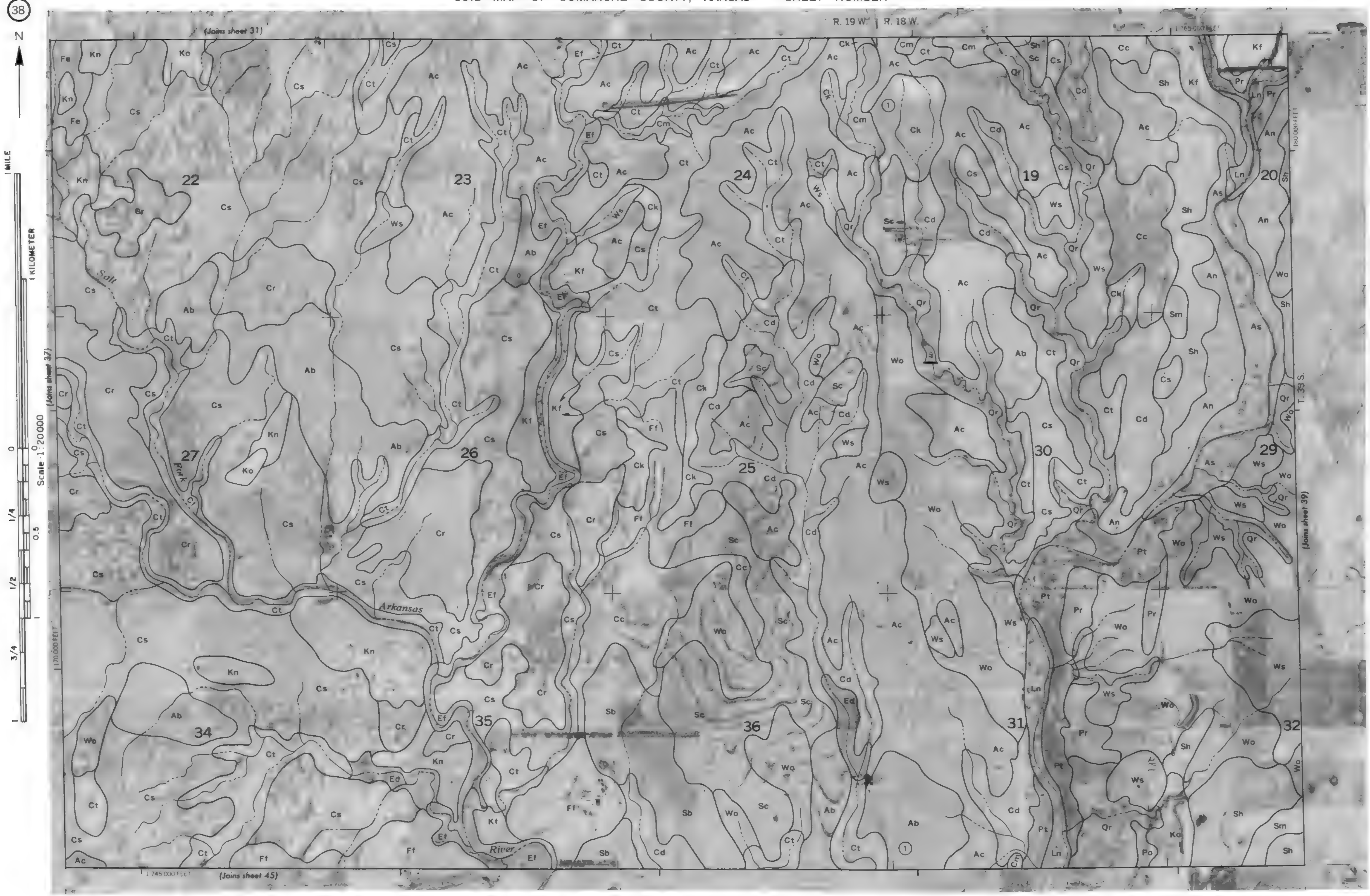

34
N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 27)
R. 17 W. | R. 16 W.
(Joins sheet 33)
(Joins sheet 35)
(Joins sheet 41)
T. 33 S.
Indian
Creek
Owl
Creek
Wildcat
Creek


R. 16 W. (Joins sheet 28)
1 840 000 FEET
195 000 FEET
T. 33 S.
(Joins sheet 34)
(Joins sheet 42)
1 860 000 FEET
185 000 FEET
BARBER COUNTY
Indian Creek
Mule Creek
water
N
1 MILE
1 KILOMETER
Scale 1:20000

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 36



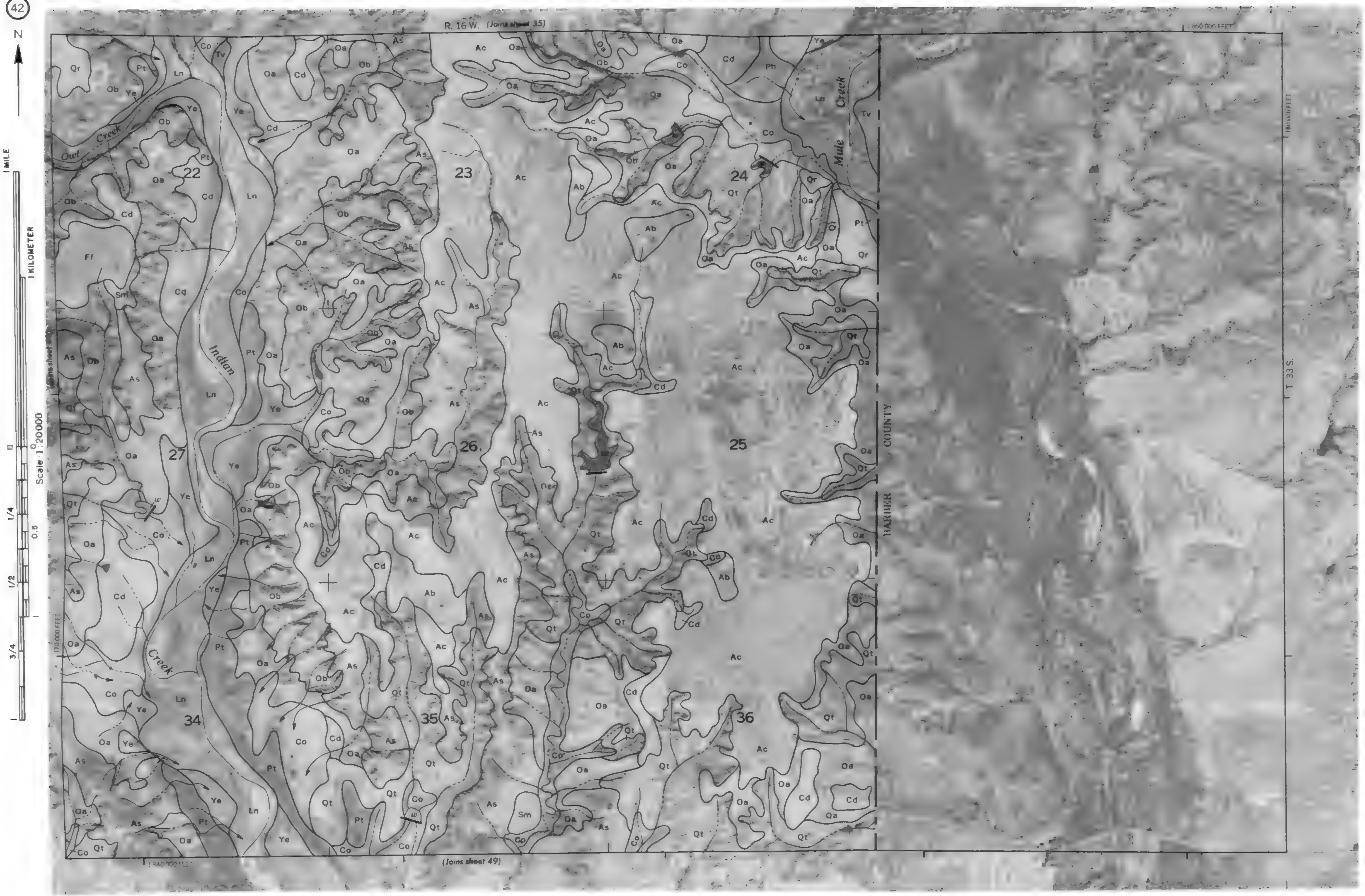

37
N
(Joins sheet 30)
(Joins sheet 38)
(Joins sheet 44)
(Joins sheet 36)
1 720 000 FEET
1 740 000 FEET
180 000 FEET
170 000 FEET
R. 20 W.
R. 19 W.
T. 33 S.
19
20
21
23
24
25
26
28
29
30
31
32
33
35
36
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

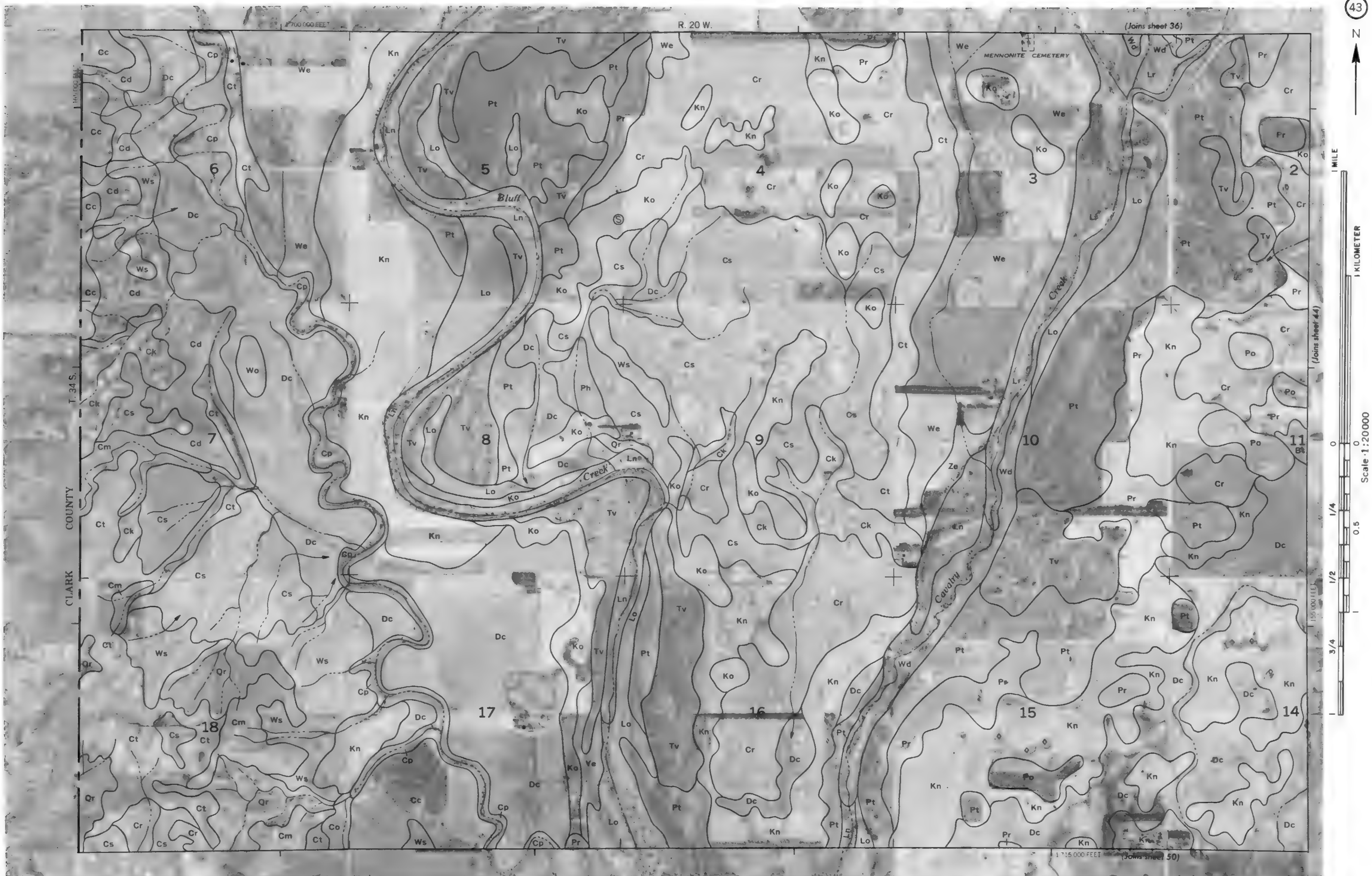

N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
(Joins sheet 31)
(Joins sheet 37)
(Joins sheet 39)
(Joins sheet 45)
R. 19 W.
R. 18 W.
T. 33 S.
1 765 000 FEET
1 745 000 FEET
170 000 FEET
180 000 FEET
Salt
Fork
Arkansas
River
19
20
22
23
24
25
26
27
29
30
31
32
34
35
36


39
N
R. 18 W.
(Joins sheet 32)
(Joins sheet 38)
(Joins sheet 40)
(Joins sheet 46)
T. 33 S.
1 770 000 FEET
180 000 FEET
170 000 FEET
1 790 000 FEET
20
21
22
23
24
25
26
27
28
29
32
33
34
35
36
water
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5

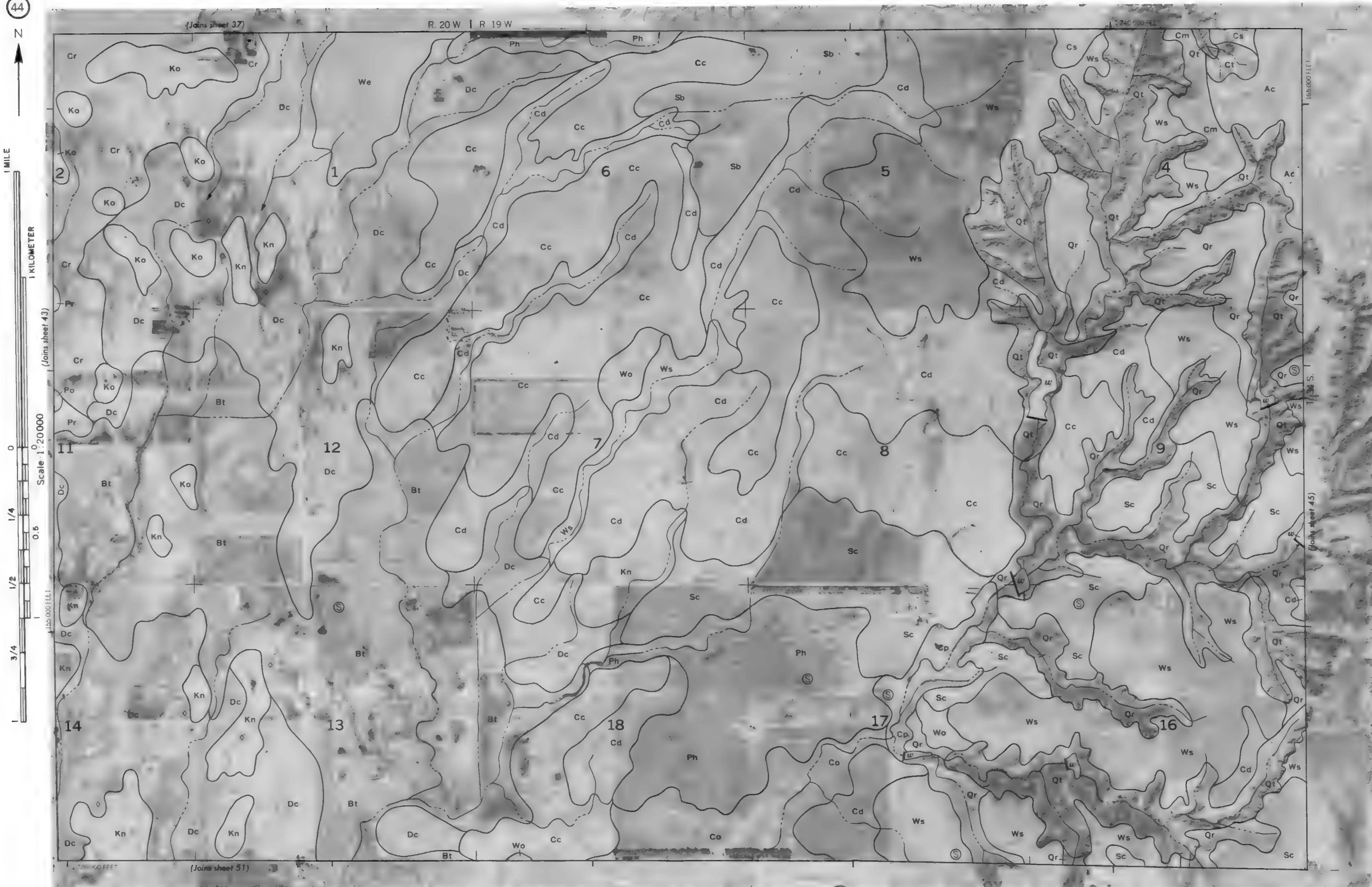

N
(Joins sheet 33)
R. 17 W.
(Joins sheet 39)
(Joins sheet 41)
(Joins sheet 47)
T. 33 S.
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
Nescatunga
Creek
Cave
Creek
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35

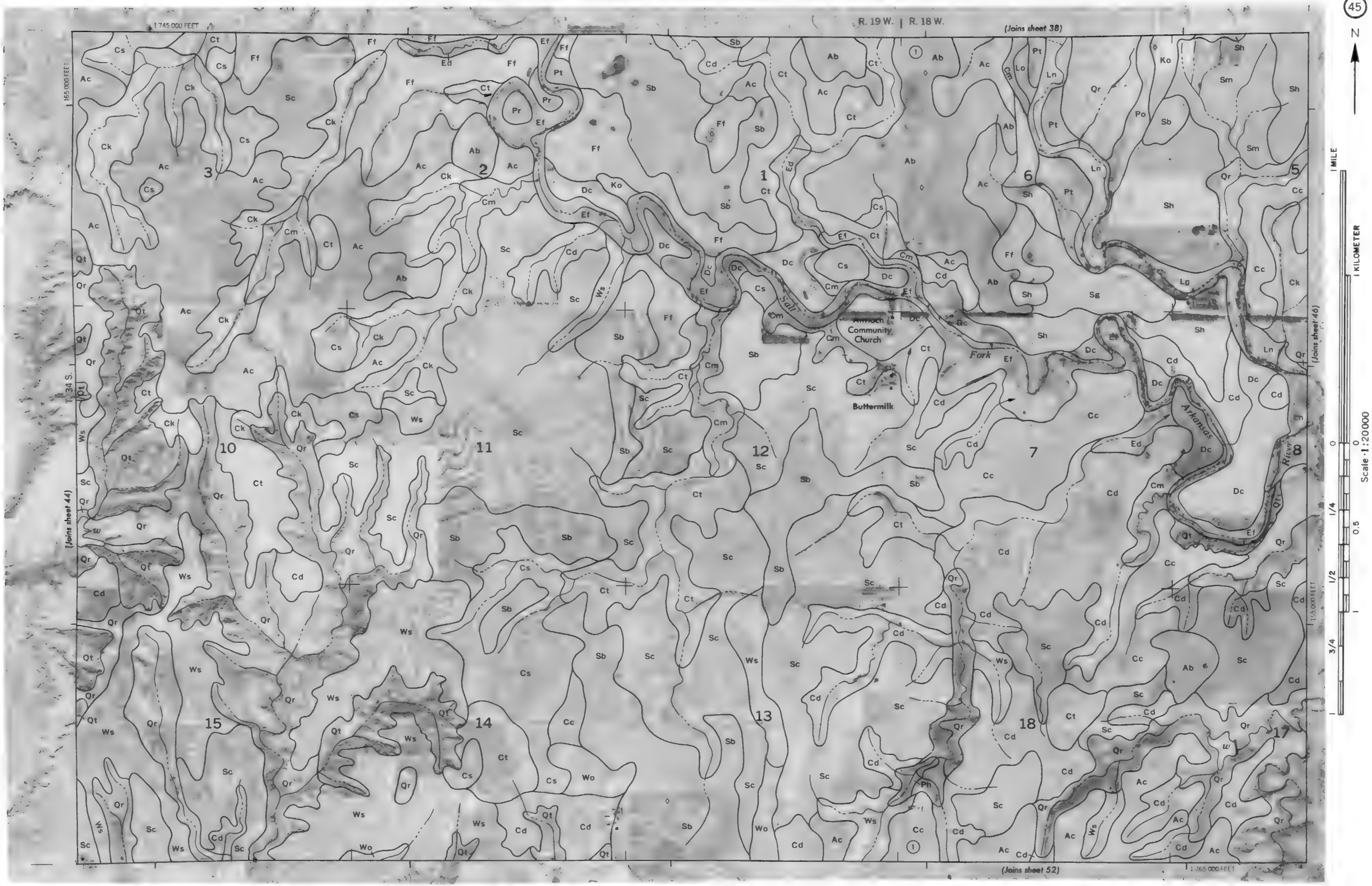

41
N
(Joins sheet 34)
(Joins sheet 40)
(Joins sheet 42)
(Joins sheet 48)
R. 17 W.
R. 16 W.
T. 33 S.
Cave Creek
Wildcat Creek
Dog Creek
Pt Creek
Owl Cr
23
24
19
20
21
26
25
30
29
28
35
36
31
32
33
1 MILE
1 KILOMETER
Scale 1:20000


42
N
1 MILE
1 KILOMETER
Scale 1:20000
R. 16 W. (Joins sheet 35)
(Joins sheet 49)
T. 33 S.
BARBER COUNTY
Owl Creek
Indian Creek
Mule Creek
22
23
24
25
26
27
34
35
36


43
N
R. 20 W.
(Joins sheet 36)
MENNONITE CEMETERY
Bluff
Creek
Cavalry
Creek
CLARK
COUNTY
T. 34 S.
(Joins sheet 44)
(Joins sheet 50)
1 MILE
1 KILOMETER
Scale 1:20000

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 44



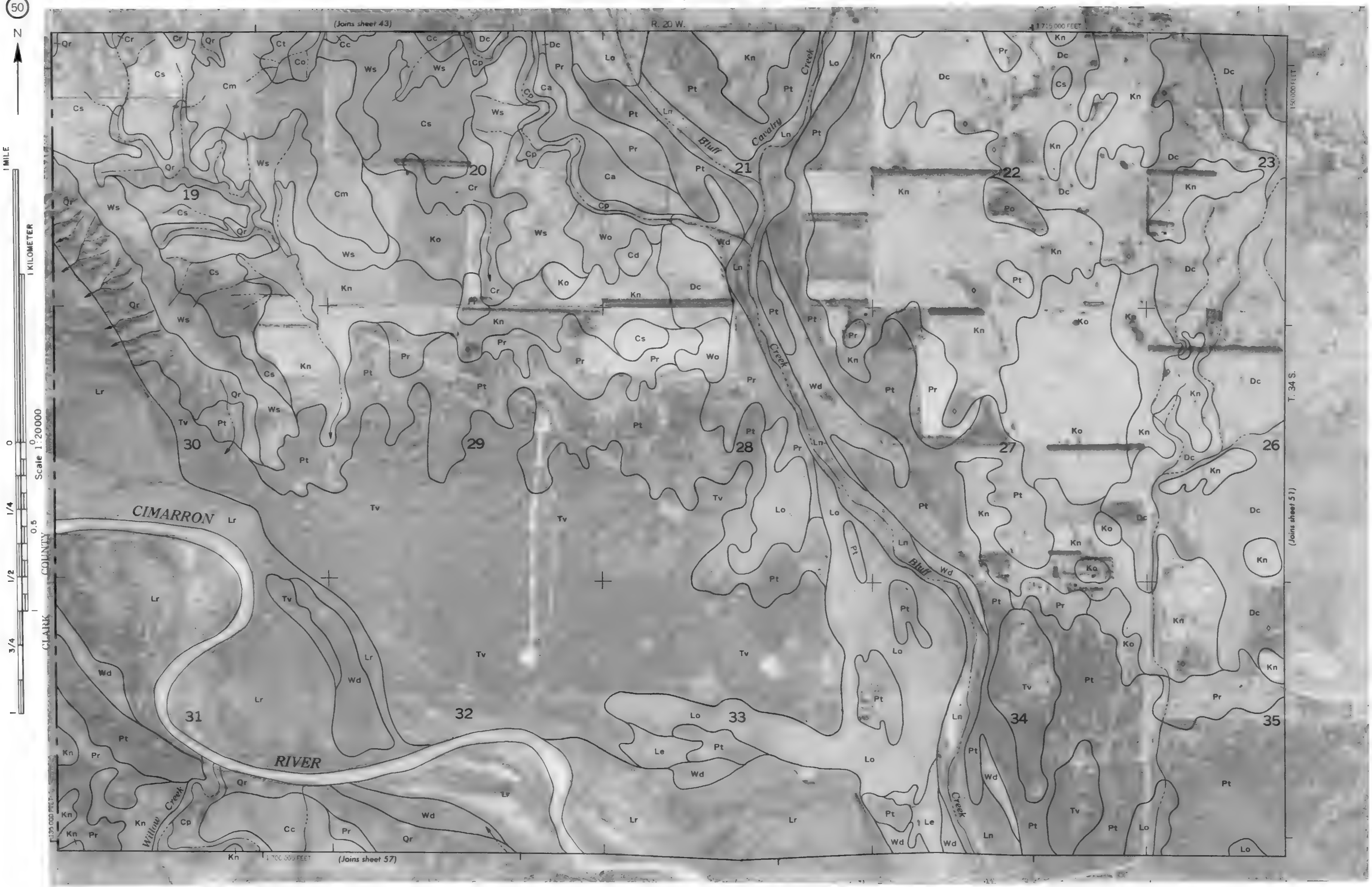

45
N
R. 19 W.
R. 18 W.
(Joins sheet 38)
(Joins sheet 44)
(Joins sheet 46)
(Joins sheet 52)
1 745 000 FEET
165 000 FEET
155 000 FEET
1 765 000 FEET
T. 34 S.
Antioch Community Church
Buttermilk
Salt Fork
Arkansas River
1 MILE
1 KILOMETER
Scale 1:20000

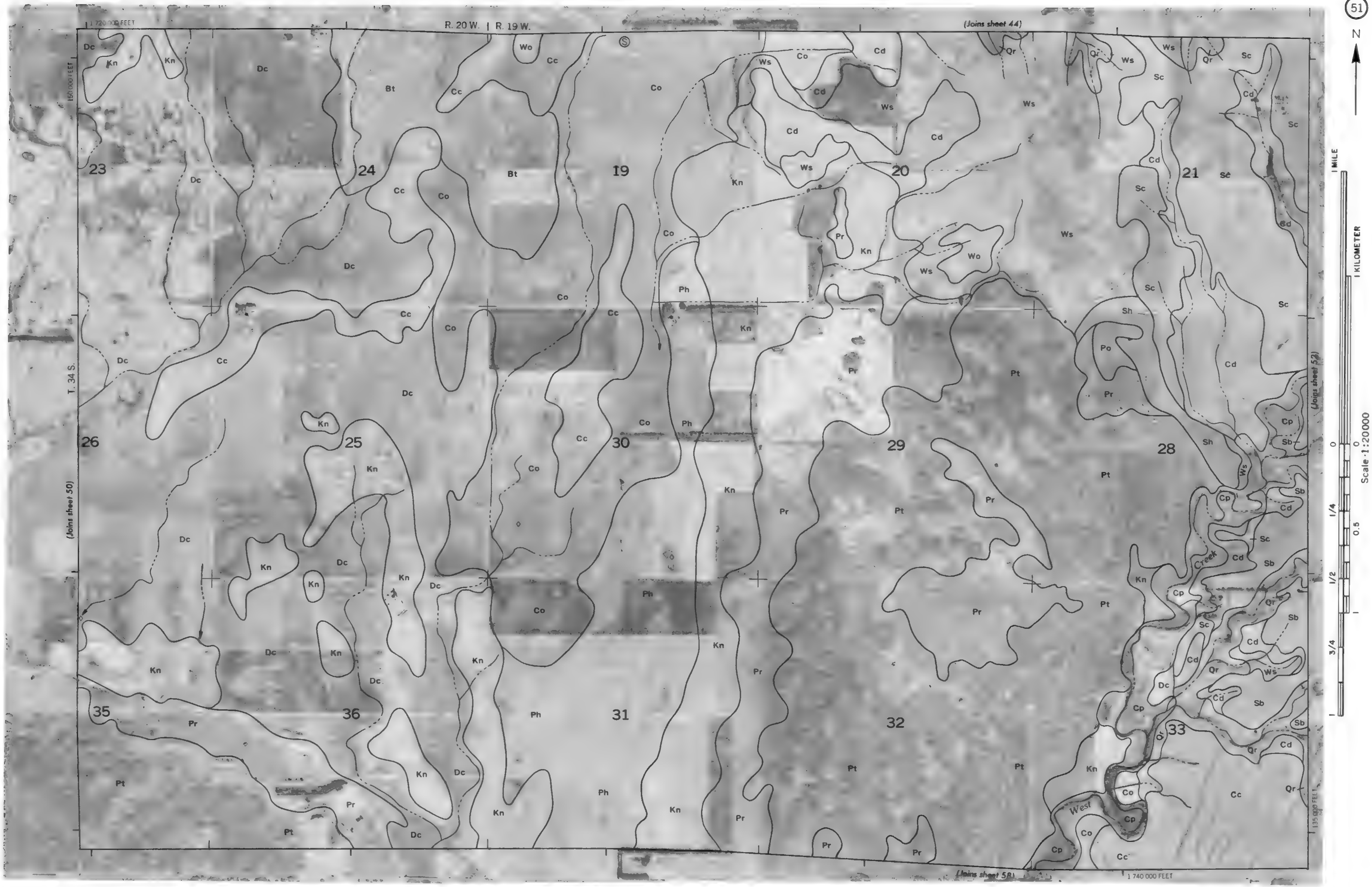

N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 39)
R. 18 W.
1 790 000 FEET
(Joins sheet 47)
T. 34 S.
(Joins sheet 53)
155 000 FEET
Salt Fork
Arkansas River
Sheely Creek
water


47
N
R. 17 W.
(Joins sheet 40)
(Joins sheet 46)
(Joins sheet 48)
(Joins sheet 54)
T. 34 S.
1 795 000 FEET
1 810 000 FEET
155 000 FEET
Salt Fork
Arkansas River
Nescatunga Creek
Creek
Cottonwood
Mustang
1 MILE
1 KILOMETER
Scale 1:20000

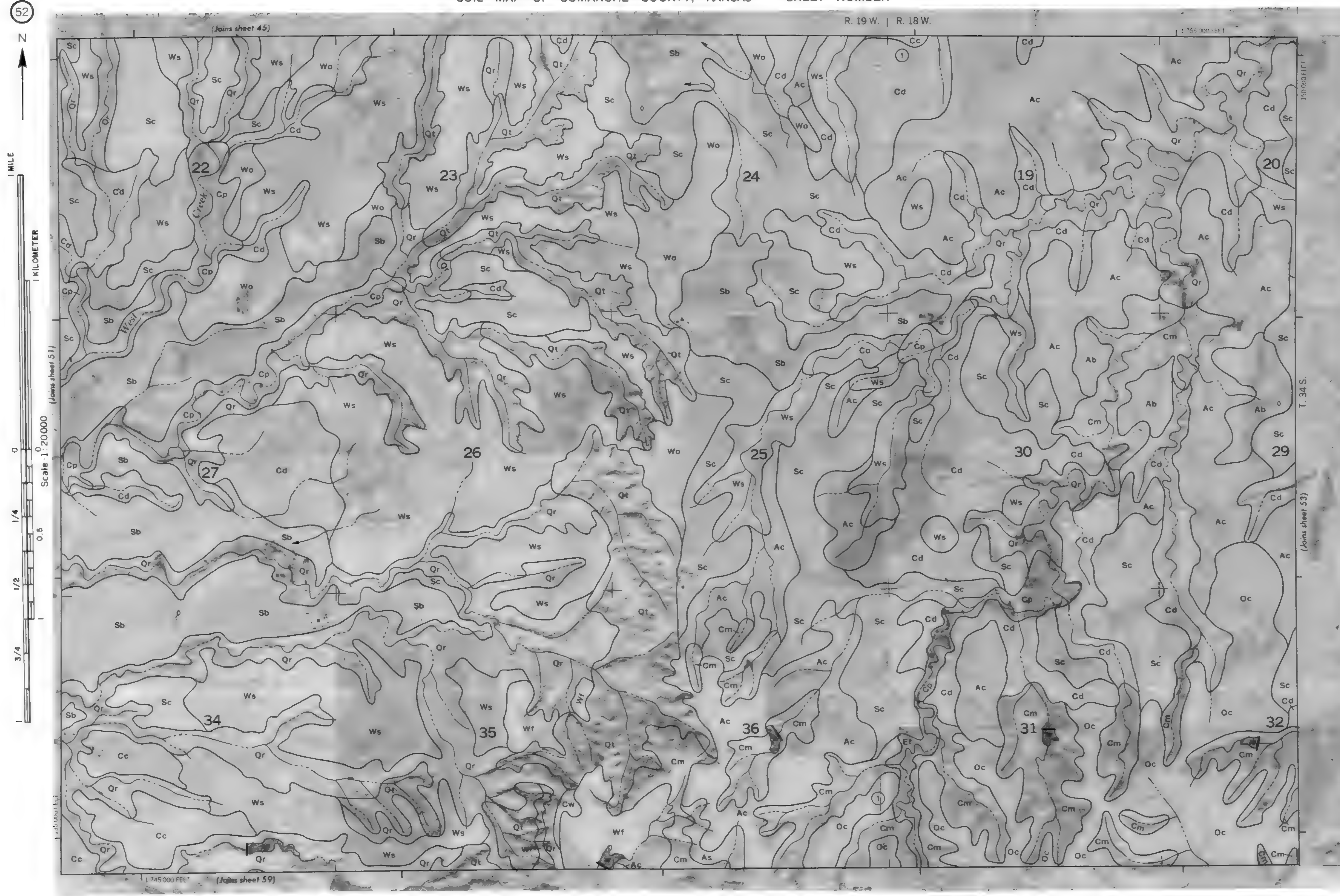

48
N
(Joins sheet 41)
R. 17 W.
R. 16 W.
Wildcat
Creek
Cave
Creek
Salt
Fork
Arkansas
River
Dog Cr
Mustang
FANCY
CANYON
Red
(Joins sheet 47)
(Joins sheet 49)
(Joins sheet 55)
T. 34 S.
1 MILE
1 KILOMETER
Scale 1:20000


49
N
R. 16 W. (Joins sheet 42)
(Joins sheet 56)
(Joins sheet 48)
T. 34 S.
Indian Creek
SALT FORK
Red Fork Creek
ARKANSAS
RIVER
BARBER COUNTY
1 MILE
1 KILOMETER
Scale 1:20000
1 640 000 FEET
1 660 000 FEET


50
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
1
3/4
1
(Joins sheet 43)
R. 20 W.
1 715 000 FEET
T. 34 S.
(Joins sheet 51)
(Joins sheet 57)
1 700 000 FEET
CLARK COUNTY
CIMARRON
RIVER
Bluff
Creek
Cavalry
Creek
Willow
Creek
19
20
21
22
23
26
27
28
29
30
31
32
33
34
35


51
N
(Joins sheet 44)
(Joins sheet 50)
(Joins sheet 52)
(Joins sheet 58)
R. 20 W. | R. 19 W.
T. 34 S.
1 740 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
Dc Kn Wo Cc Co Cd Ws Qr Sc Bt Pr Ph Pt Sh Po Cp Sb
23 24 19 20 21 26 25 30 29 28 35 36 31 32 33
West Creek

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 52

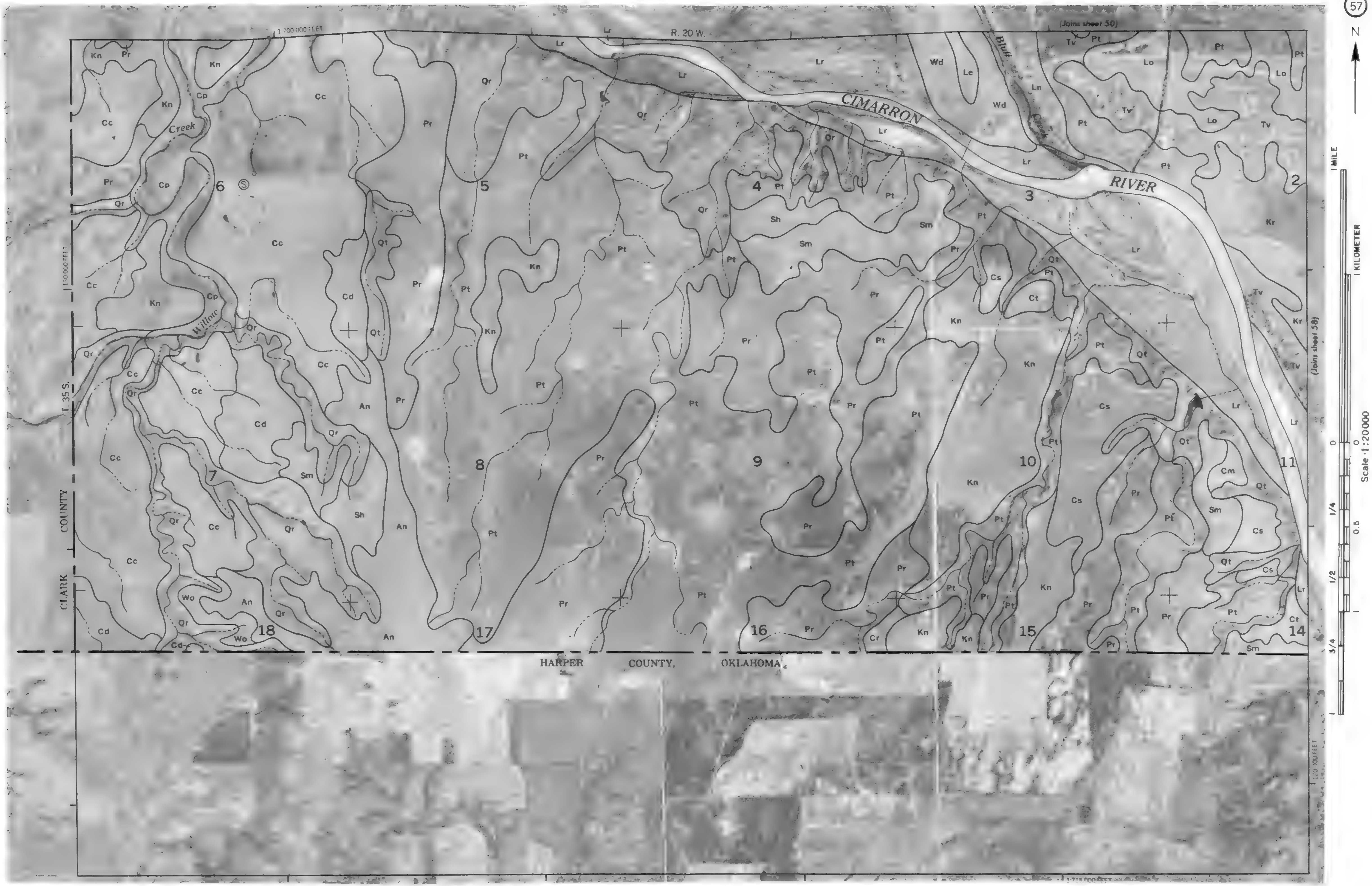


SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 53

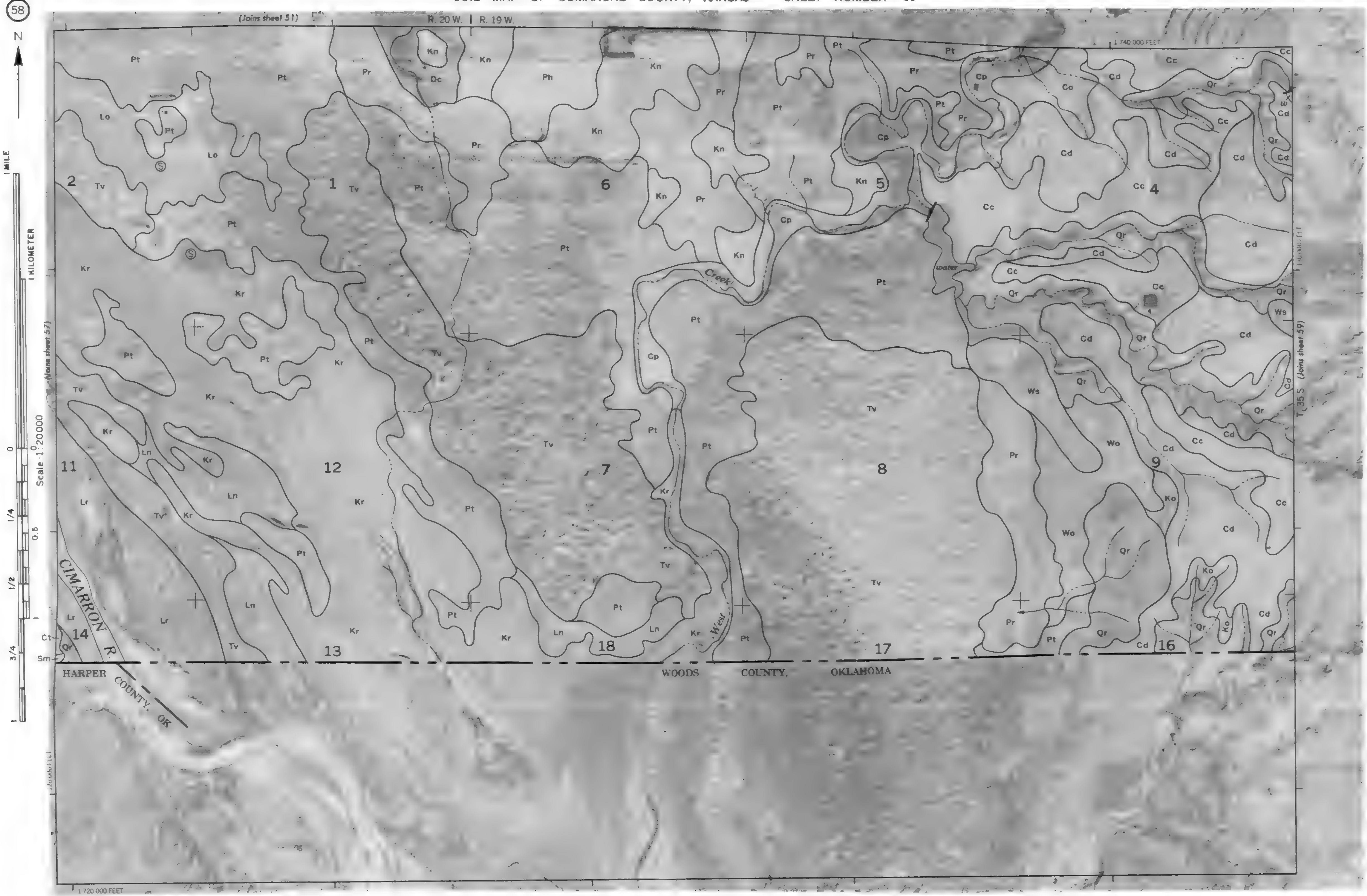
SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 54

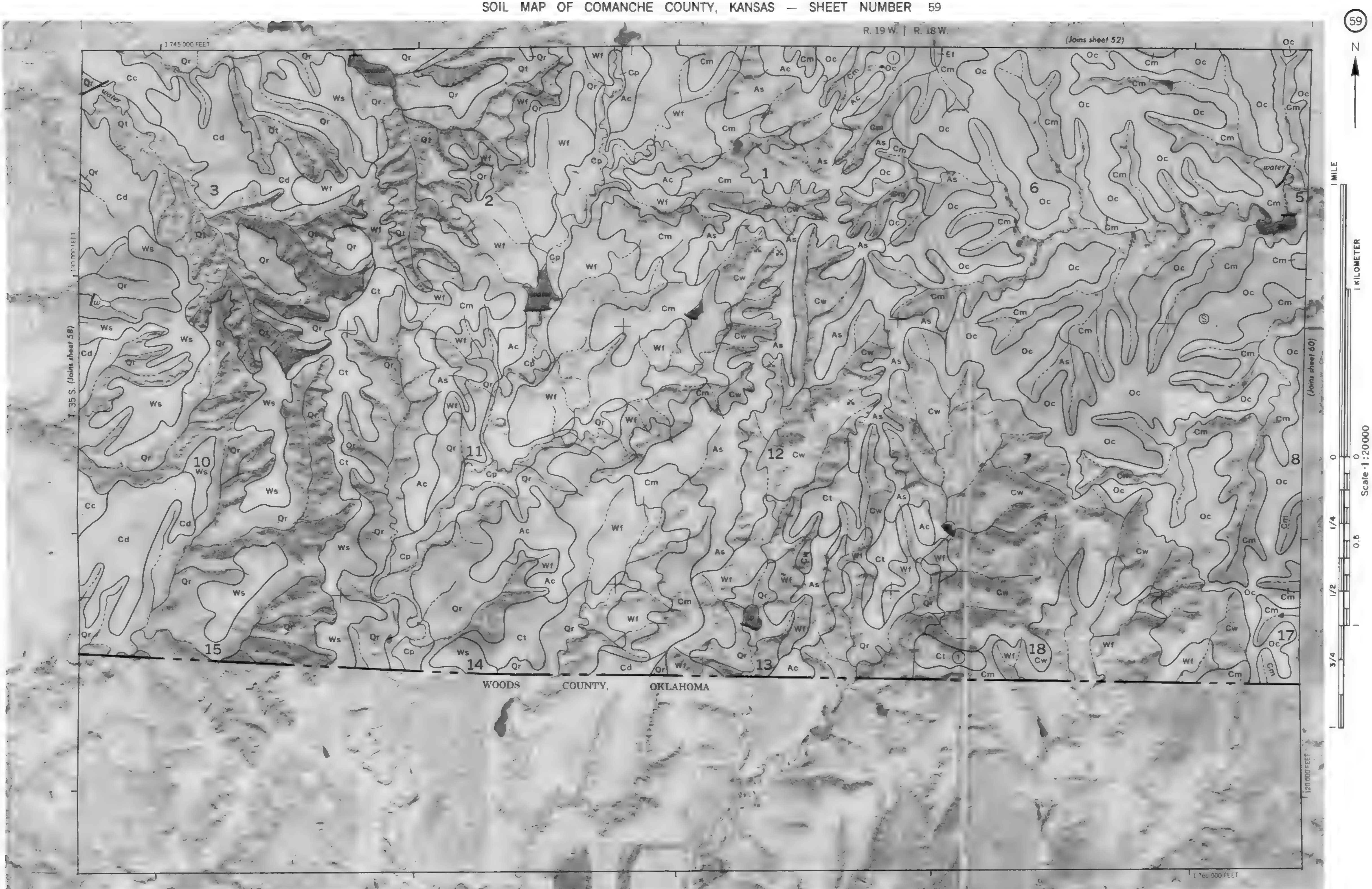

55
N
R. 17 W. | R. 16 W.
(Joins sheet 48)
(Joins sheet 54)
(Joins sheet 56)
(Joins sheet 62)
T. 34 S.
CHRISTY
CANYON
FANCY
CANYON
Red
Fork
Creek
1 MILE
1 KILOMETER
Scale 1:20000

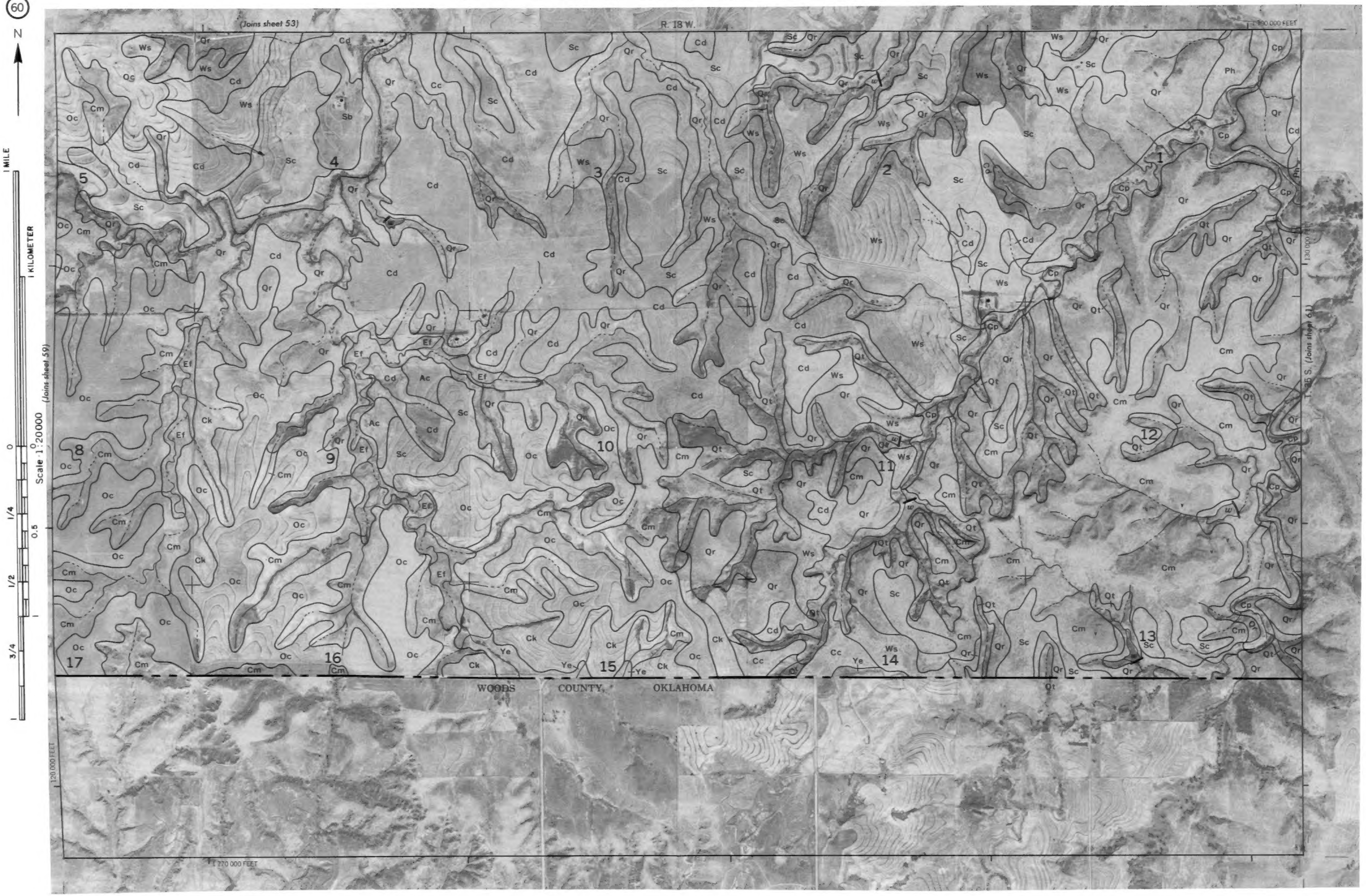

56
N
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
0.5
1/2
3/4
1
R. 16 W. (Joins sheet 49)
(Joins sheet 55)
(Joins sheet 63)
840 000 FEET
BARBER COUNTY
T. 34 S.
Creek
22
23
24
25
26
27
35
36
Ab
Sc
Sb
Sh
Sm
Cs
Cd
Cp
Co
Oa
Ob
Qr
Qt
Ws


57
N
(Joins sheet 50)
(Joins sheet 58)
R. 20 W.
T. 35 S.
CIMARRON RIVER
Willow Creek
Bluff Creek
CLARK COUNTY
HARPER COUNTY, OKLAHOMA
1 700 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5

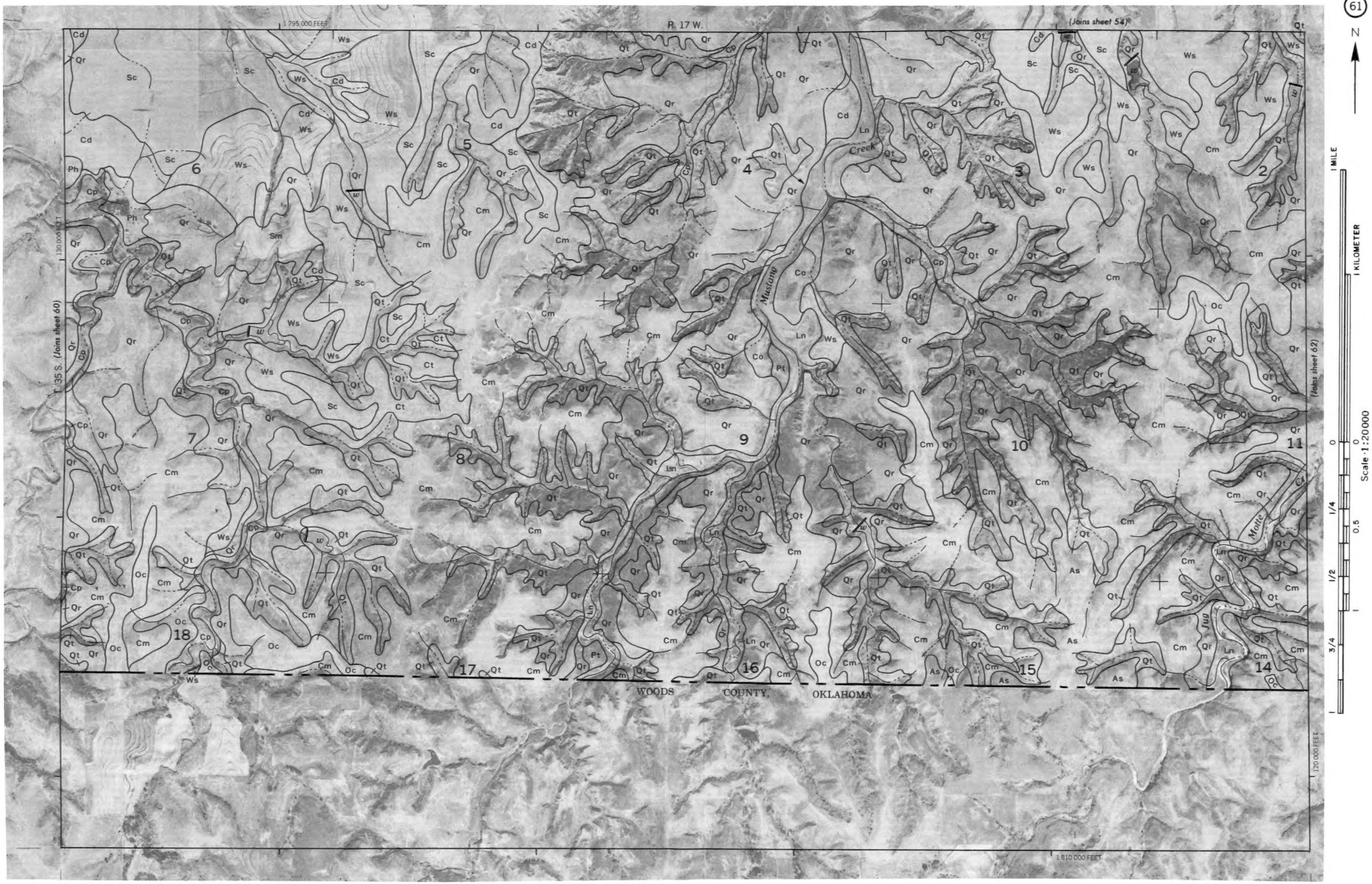
SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 58



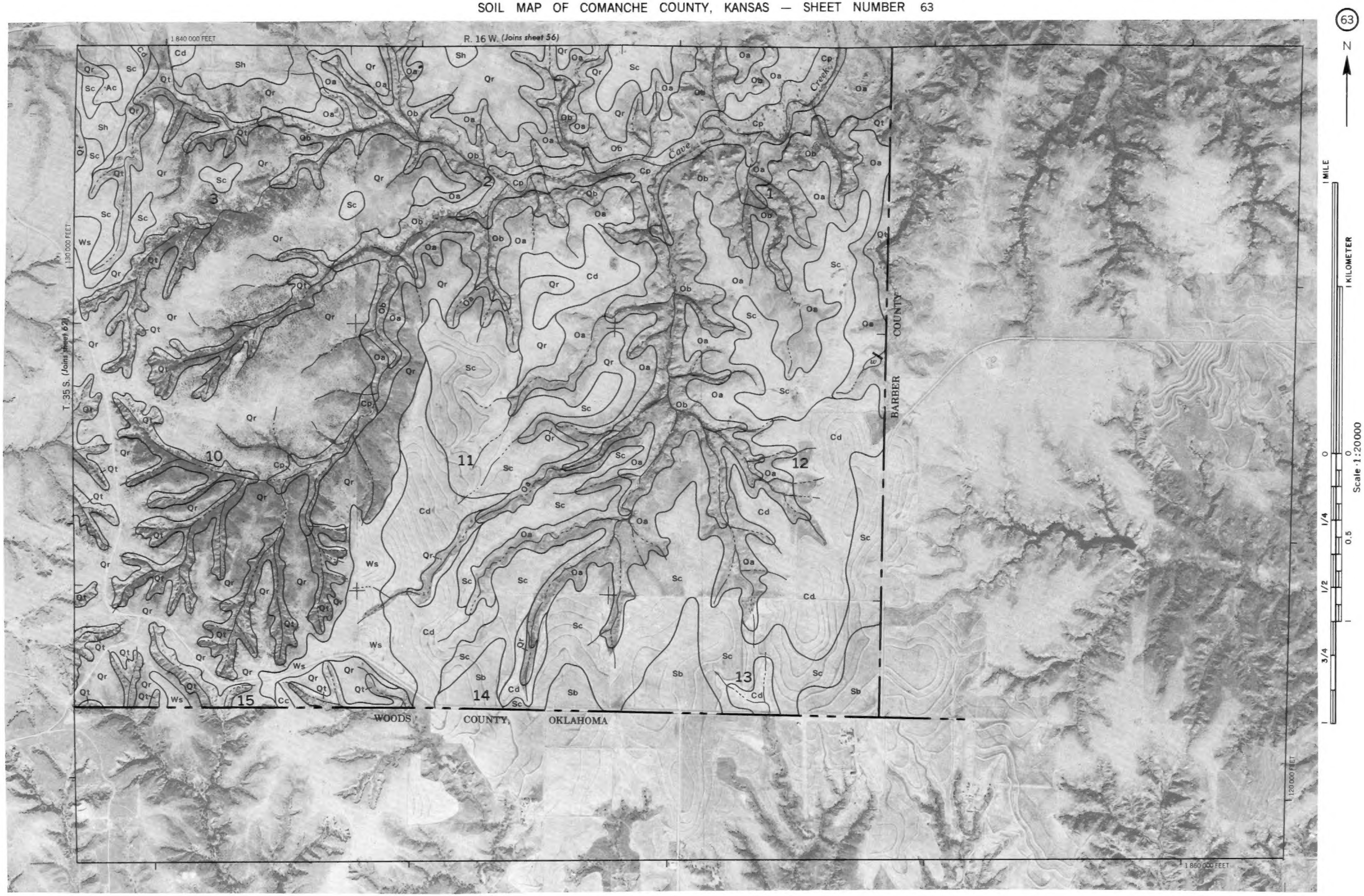

59
N
R. 19 W. | R. 18 W.
1 745 000 FEET
(Joins sheet 52)
(Joins sheet 58)
(Joins sheet 60)
T. 35 S.
130 000 FEET
120 000 FEET
1 765 000 FEET
WOODS COUNTY, OKLAHOMA
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
1
0.5
water


N
1 MILE
1 KILOMETER
Scale 1:20000
(Joins sheet 53)
R. 18 W.
130 000 FEET
T. 35 S.
(Joins sheet 61)
(Joins sheet 59)
WOODS COUNTY, OKLAHOMA
1 770 000 FEET
120 000 FEET

SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 61



SOIL MAP OF COMANCHE COUNTY, KANSAS — SHEET NUMBER 62



63
N
R. 16 W. (Joins sheet 56)
1 840 000 FEET
T. 35 S. (Joins sheet 62)
130 000 FEET
Cave Creek
BARBER COUNTY
WOODS COUNTY, OKLAHOMA
120 000 FEET
1 860 000 FEET
1 MILE
1 KILOMETER
Scale 1:20000
0
1/4
1/2
3/4
0.5